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# he Department of Defense

DoD DEPARTMENTS/AGENCIES:



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Defense  
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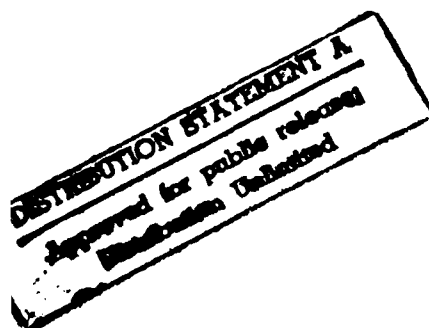


Defense  
Nuclear  
Agency



Strategic Defense  
Initiative  
Organization

## DEFENSE SMALL BUSINESS INNOVATION RESEARCH PROGRAM (SBIR)



92-10217



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**FY 1990 SBIR SOLICITATION  
PHASE I AWARD ABSTRACTS  
DNA, DARPA AND SDIO PROJECTS**

**VOLUME IV**

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## PREFACE

This report presents the technical abstracts of the Phase I proposals resulting in contract awards in Fiscal Year 1990 that were submitted to the Department of Defense (DoD) Small Business Innovation Research (SBIR) Program. The Army, Navy, Air Force, Defense Advanced Research Projects Agency (DARPA), Defense Nuclear Agency (DNA), and Strategic Defense Initiative Organization (SDIO) are the DoD components of the SBIR Program. Two solicitations inviting small business firms to submit proposals under this program were published in FY90. All six DoD components participated in Program Solicitation 90.1 (Closing Date: 5 January 1990), and Army, Navy, and DARPA participated in Program Solicitation 90.2 (Closing Date: 2 July 1990). The selection of proposals for funding was made from proposals received by the Military Services and Agencies.

### FY 1990 SBIR PROGRAM

	<u>Number of Topics</u>		<u>Proposals Received</u>		<u>Phase I Awards</u>	
	<u>90.1</u>	<u>90.2</u>	<u>90.1</u>	<u>90.2</u>	<u>90.1</u>	<u>90.2</u>
Army	206	273	2482	2094	218	272
Navy	310	78	2132	520	334	78
Air Force	199	--	2524	--	233	--
DARPA	61	70	754	563	94	85
DNA	17	--	254	--	16	--
SDIO	15	--	710	--	97	--
Total	808	421	8856	3177	992	435
Grandtotal	1229		12033		1427	

Of the 1427 Phase I awards made in 1990, 180 awards went to minority-owned businesses and 113 awards were to woman-owned businesses. Overall, 11.9% of 1990 SBIR proposals were selected for funding, that is better than a 1 in 9 chance of receiving an award.

In order to make information available on the technical content of the Phase I projects supported by the DoD SBIR Program, four volumes containing the abstracts and contacts for the 1427 awarded projects are published. The small business information with accompanying abstract are arranged in topic number order. When more than one award was made for a given topic, the information is in alphabetical order by firm.

- Volume I contains Army Projects
- Volume II contains Navy Projects
- Volume III contains Air Force Projects
- Volume IV contains DNA, DARPA and SDIO Projects

Venture capital and large industrial firms that may have an interest in the research described in the abstracts in this publication are encouraged to contact the firm whose name and address is shown.

## INTRODUCTION

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In 1982, Congress enacted and the President signed the "Small Business Innovation Development Act of 1982" (Public Law 97-219), which created the Small Business Innovation Research (SBIR) Program to give small, high-technology firms a greater share of the federally-funded research and development contract awards.

Under the SBIR Program, each federal agency with an extramural budget for research or research and development in excess of \$100 million per fiscal year must establish an SBIR Program. The program is funded by setting aside 1.25 percent of the participating agency's extramural R&D contracting dollars. The agency's participating in the Department of Defense SBIR Program are Army, Navy, Air Force, Defense Advanced Research Projects Agency (DARPA), Defense Nuclear Agency (DNA), and Strategic Defense Initiative Organization (SDIO).

The objectives of the DoD SBIR Program include stimulating technological innovation in the private sector, strengthening the role of small business in meeting DoD research and development needs, encouraging participation by minority and disadvantaged persons in technological innovation, and increasing the commercial application of DoD-supported research or research and development.

The SBIR Program consists of three distinct phases. Under Phase I, DoD Components make awards to small businesses, typically of up to one man-year effort over a period generally of six months, subject to negotiation. Phase I is to determine, insofar as possible, the scientific or technical merit and feasibility of ideas or concepts submitted in response to SBIR topics. Proposals selected for contract award are those which contain an approach or idea that holds promise to provide an answer to the specific problem addressed in the topic. Successful completion of Phase I is a pre-requisite for further DoD support in Phase II.

Phase II awards will be made only to firms on the basis of results from the Phase I effort, and the scientific and technical merit of the Phase II proposal. Proposals which identify a follow-on Phase III funding commitment from non-Federal sources will be given special consideration. Phase II awards will typically cover two to five man-years of effort over a period generally of 24 months, also subject to negotiation. The number of Phase II awards will depend upon the success rate of the Phase I effort and availability of funds. Phase II is the principal research or research and development effort, and requires comprehensive proposal outlining the intended effort in detail.

Phase III is expected to involve private sector investment and support for any necessary development that will bring an innovation to the marketplace. Also, under Phase III, DoD may award follow-on contracts not funded by the SBIR Program for products or processes meeting DoD mission needs.

Proposals received in response to a DoD solicitation are evaluated on a competitive basis in the organization which generated the topic, by scientists and engineers knowledgeable in that area. Selections for Phase I are made in accordance with the following four criteria:

- The scientific/technical quality of the research proposal and its relevance to the topic description, with special emphasis on its innovation and originality.
- Qualifications of the principal investigator, other key staff, and consultants, if any, and the adequacy of available or obtainable instrumentation and facilities.
- Anticipated benefits of the research to the total DoD research and development effort.
- Adequacy of the Phase I proposed effort to show progress toward demonstrating the feasibility of the concept.

Public Law 99-443, the "Small Business Innovation Act of 1986" was signed by the President on October 6, 1986. This law re-authorized Public Law 97-219 (signed July 22, 1982) to extend the "Sunset Clause" to 1993; to continue 1.25 percent taxation of the extramural research and development budget; and excludes from taxation those amounts of the DoD research and development budget obligated solely for operational systems development.

SMALL BUSINESS INNOVATION RESEARCH PROGRAM - PHASE I  
DNA Solicitation 90.1

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SCIENCE RESEARCH LAB, INC.

15 WARD STREET

SOMERVILLE, MA 02143

Program Manager: DR. MAHADEZAN KIRSHNAN

Contract #:

Title: HIGHLY COLLIMATED METAL VAPOR SOURCE FOR OPENING SWITCH AND Z/PINCHES

Topic #: DNA90-

Office: AM

ID #: 40215

\*\*ABSTRACT NOT AVAILABLE

AMADOR RESEARCH CORP

4737 ROSS GATE CT

PLEASANTON, CA 94566

Program Manager: DR D LYNN SHAEFFER

Contract #:

Title: RESPONSE OF SUPERCONDUCTING MATERIALS AND ELECTRONICS TO TRANSIENT RADIATION

Topic #: DNA90-003

Office: AM

ID #: 40037

AN EXPERIMENT IS PROPOSED TO DEMONSTRATE THAT TRANSIENT X-RAY RADIATION FROM THE PHYSICS INTERNATIONAL PULSERAD 1150 FLASH X-RAY MACHINE WILL CAUSE A REPRESENTATIVE HIGH TEMPERATURE SUPERCONDUCTING (HTS) DEVICE TO MALFUNCTION BY REVERTING TO NORMAL CONDUCTIVITY. INTEREST IN THIS PHENOMENON IS MOTIVATED BY THE ANTICIPATED INCORPORATION OF HTS THIN FILM TECHNOLOGY IN DEFENSE ELECTRONICS, ESPECIALLY SATELLITES, IN THE NEAR-FUTURE. THE ELECTRONICS WILL BE VULNERABLE (I.E., RADIATION SOFT) TO SPACE RADIATION OR A NUCLEAR WEAPON RADIATION ENVIRONMENT. POTENTIALLY DAMAGING TRANSIENT VOLTAGES WILL OCCUR WHEN THE HTS MATERIAL GOES NORMAL. PERMANENT DAMAGE MAY ALSO RESULT. THE DEVICE CHOSEN HERE IS A LOW-Q MICROWAVE RESONATOR MANUFACTURED BY WESTINGHOUSE SCIENCE AND TECHNOLOGY CENTER AND CONSISTING OF YBCO DEPOSITED ON A MgO SUBSTRATE. ALTHOUGH HIGH-Q HTS RESONATORS ARE AVAILABLE, A LOW-Q RESONATOR WILL RESPOND IN A TIME SHORT COMPARED TO THE 50 ns X-RAY PULSE. THE S(12) PARAMETER WILL BE MEASURED AS A FUNCTION OF FREQUENCY WITH A SYNTHESIZER, S-PARAMETER TEST SET, AND NETWORK ANALYZER. A WIDEBAND OSCILLOSCOPE WILL BE EMPLOYED TO MEASURE RESPONSE AS A FUNCTION OF TIME. THE Q AND DEVICE RESISTANCE WILL BE OBTAINED AS A FUNCTION OF TIME, DOSE, AND DOSE RATE.

ARES CORP

1111 N 19TH ST - STE 305

ARLINGTON, VA 22209

Program Manager: CLIFFORD McLAIN

Contract #:

Title: NEW TECHNOLOGIES FOR IMPROVED SIMULATION OF NUCLEAR WEAPON EFFECTS

Topic #: DNA90-004

Office: AM

ID #: 40040

THE ARES CORPORATION HAS TEAMED WITH THE CALIFORNIA MUNITIONS DEVELOPMENT CORPORATION (CAMDEC) TO PROPOSE AN INNOVATIVE CONCEPT FOR IMPROVING THE FIDELITY AND FLEXIBILITY OF HE NUCLEAR EFFECTS SIMULATION. THIS CONCEPT OFFERS A SIMPLE, LOW COST, UNIFORM, AND HOMOGENEOUS TEST CHARGE THROUGH THE USE OF A CONSUMABLE CONTAINER, WHICH ITSELF TAKES PART IN THE DETONATION PROCESS ELIMINATING CONTAINER DEBRIS AS A TEST ENVIRONMENT CONTAMINANT. THIS CONCEPT USES A FIBER REINFORCED BLASTING AGENT HELD IN A RUBBER LIKE MATRIX TO ACHIEVE A CONTAINER HAVING STRUCTURAL STRENGTH, WHICH ASSUMES THE DESIRED HE CHARGE GEOMETRIC CONFIGURATION WHEN FILLED WITH BLASTING AGENT (ANFO). THE CONTAINER

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DNA Solicitation 90.1

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CONSTRUCTION IS MUCH LIKE THAT OF A LARGE LOW PRESSURE TIRE. THE HIGH STRENGTH, HYDROCARBON, CONTAINER REINFORCING FIBERS WILL BE LARGELY CONSUMED DURING THE BLAST AND, IN ANY EVENT, WILL NOT FORM LARGE PARTICLES. INERT COMPONENTS WILL CONSTITUTE LESS THAN 0.2% OF THE TOTAL HE CHARGE. THE COMPLIANT CONTAINER ALSO PERMITS SIMPLE LOW COST FOOTINGS FOR GROUND MOUNTED CHARGES, AND SIMPLE SUSPENDED CHARGE SYSTEMS. IN SUMMARY, THE ARES TEAM CONCEPT PROVIDES A TECHNIQUE WHEREBY HE SIMULATION CHARGES CAN SUPPORT A WIDE VARIETY OF CONFIGURATIONS AND PROVIDE THE EFFECT OF A HOMOGENEOUS COMPLETELY BARE CHARGE WITH THE STRUCTURAL INTEGRITY OF A CONTAINED CHARGE.

GENERAL SCIENCES INC

205 SCHOOLHOUSE RD

SOUDERTON, PA 18964

Program Manager: DR PETER D ZAVITSANOS

Contract #:

Title: SIMULATION OF DUST CLOUDS FOR MISSILE COMPONENT TESTS

Topic #: DNA90-004

Office: AM

ID #: 40046

AN EXPERIMENTAL PROGRAM IS PROPOSED TO INVESTIGATE THE TRANSFER OF PROVEN TECHNOLOGY PREVIOUSLY ADAPTED FOR SOUNDING ROCKET CHEMICAL RELEASES AND THERMAL SIMULATION, TO PROVIDE A DUST LADEN FIELD THAT SIMULATES A NUCLEAR BURST ENVIRONMENT. THIS INVESTIGATION PROPOSES THE USE OF AN EXOTHERMIC SOLID STATE PARTICLE/PARTICLE REACTION AND IN COMBINATION WITH INERT DUST PARTICLES, TO CREATE THE CLOUD REQUIREMENTS. EXPERIENCE HAS SHOW THAT THE REACTION PROVIDES OVER 95% OF THE MASS TO THE PARTICLE FIELD AS OPPOSED TO HIGH ENERGY EXPLOSIVES THAT PROVIDE LESS THAN 10% OF THE MASS TO THE PARTICLE FIELD (HENCE THE REQUIREMENT OF HIGH DOSAGE LEVELS). MOREOVER, EXPERIENCE HAS SHOWN THAT THE CLOUD MASS DENSITY AND PARTICLE SIZE CAN BE CONTROLLED AS WELL AS THE CLOUD SIZE. IN ORDER TO MAXIMIZE THE FLIGHT DISTANCE WITH MINIMUM WEIGHT IT IS PROPOSED TO PRODUCE AN ELONGATED HIGH DENSITY CLOUD COMPOSED OF SEVERAL CLOUDS (IN SERIES GENERATED BY INDIVIDUAL CANISTERS). THE LOW RELEASE PRESSURE IN COMBINATION WITH PARTICULATE PRODUCTS (95% OF TOTAL) ALLOWS THE HIGHER DENSITY AS COMPARED TO THOSE GENERATED BY EXPLOSIVES. THE PROPOSED PROGRAM FEATURES A SUB-SCALE EXPERIMENT THAT ALLOWS FOR DIAGNOSTICS OF THE CLOUD DEVELOPMENT AND EFFECTIVENESS; FURTHER EVALUATION WILL UTILIZE STATE-OF-THE-ART RESPONSE CODES.

MISSION RESEARCH CORP

1720 RANDOLPH RD SE

ALBUQUERQUE, NM 87106

Program Manager: GARY R HESS

Contract #:

Title: PLASMA DRIVEN WATER SHOCK

Topic #: DNA90-004

Office: AM

ID #: 40054

DEVELOPMENT OF A HIGH FIDELITY, HIGH ENERGY DENSITY WATER SHOCK SIMULATOR APPEARS FEASIBLE. MISSION RESEARCH CORPORATION (MRC), WITH THE ASSISTANCE OF THE NEW MEXICO ENGINEERING RESEARCH INSTITUTE (NMERI), PROPOSES TO DEVELOP AN ELECTRICAL WATER SHOCK SIMULATOR WHERE AN ELECTRICAL DISCHARGE ACROSS A WELL DEFINED ELECTRODE GAP WILL PRODUCE A HOT PLASMA EXPANSION WHICH RESULTS IN A FAST RISE PRESSURE PULSE. THIS PHASE I EFFORT WILL FOCUS EXCLUSIVELY ON THE PERFORMANCE OF A PROOF-OF-PRINCIPLE EXPERIMENT AND SUPPORTING ANALYSIS. IT WILL CONSIST OF AN ANALYTICAL STUDY OF THE CRITICAL PARAMETERS TO BE DEMONSTRATED IN THE EXPERIMENT. THESE PARAMETERS INCLUDE ELECTRICAL PULSE LENGTH, ELECTRICAL PULSE ENERGY, AND THE PRESSURE PULSE PROFILE AND ENERGY. ADDITIONALLY, A BASELINE DESIGN OF A LARGE SCALE WATER SHOCK SIMULATOR PROTOTYPE WILL BE PRODUCED. THUS,

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AT THE END OF PHASE I, THE TECHNIQUE FEASIBILITY WILL HAVE BEEN ANALYZED, DEMONSTRATED, AND SCALED TO HIGHER ENERGY AND PEAK PRESSURE. A PROTOTYPE SIMULATOR CAN THEN BE DEVELOPED AND TESTED IN PHASE II.

PACIFIC-SIERRA RESEARCH CORP  
12340 SANTA MONICA BLVD  
LOS ANGELES, CA 90025

Program Manager: DR RICHARD D SMALL

Contract #: DNA001-90-C-0114

Title: URBAN DUST FROM NUCLEAR EXPLOSIONS

Topic #: DNA90-004

Office: AM

ID #: 40055

FRATRICIDE, FALLOUT, AND AIRCRAFT HAZARD ZONES ARE INFLUENCED BY NUCLEAR DUST CLOUDS. THE DUST MASS LOFTED FROM OPEN AREAS IS WELL ESTIMATED; THE AMOUNT LOFTED FROM URBAN AREAS IS NOT ESTIMATED AT ALL. SINCE MANY TARGETS ARE LOCATED IN URBAN AREAS, THE ADDITIONAL DUST LOFTED MAY BE SUBSTANTIAL. IN THIS SBIR EFFORT, WE PROPOSE TO DEVELOP A UNIQUE AND INNOVATIVE SERIES OF EXPERIMENTS THAT WILL LEAD TO FIRST ESTIMATES OF THE DUST PRODUCED IN URBAN AREAS. THE EXPERIMENTS WILL BE COINCIDENTIAL (AND THUS HIGHLY LEVERAGED AND AT MINIMAL COST TO THE DNA) WITH SCHEDULED EXPLOSIVE BUILDING DEMOLITIONS. WE PLAN TO DESIGN EXPERIMENTS TO MEASURE TOTAL BUILDING DUST MASS, COMPOSITION, AND PARTICLE SIZE DISTRIBUTION. SEPARATE TASKS RELATE THE MEASUREMENTS PERFORMED DURING BUILDING DEMOLITION TO SOVIET TARGET AREA BUILDINGS, AND THE DUST MASS PRODUCED AND SWEEPED INTO NUCLEAR CLOUDS. THE PROPOSED EXPERIMENTS AND ANALYSIS WILL LEAD TO FIRST ESTIMATES OF DUST LOFTED OVER URBAN TARGET AREAS. PREDICTIONS OF FRATRICIDE FOOTPRINTS, FALLOUT, AND LONG-LIVED CLOUDS DEFINING AIRCRAFT (ENGINE) HAZARD AREAS WILL FOR THE FIRST TIME ACCOUNT FOR URBAN DUST.

KTECH CORP  
901 PENNSYLVANIA AVE NE  
ALBUQUERQUE, NM 87110  
Program Manager: EDWARD S GAFFNEY  
Contract #:

Title: FAST-RISE HIGH PRESSURE GAUGE FOR LONG-DURATION NUCLEAR AIRBLAST

Topic #: DNA90-005

Office: AM

ID #: 40076

KTECH PROPOSES TO DEVELOP OPTICAL HOPKINSON BAR PRESSURE GAUGES FOR MEASUREMENT OF AIRBLAST ON UNDERGROUND NUCLEAR EVENTS. THE BARS WILL BE MADE OF SINGLE CRYSTAL SAPPHIRE WHICH HAS A MEASURED YIELD STRENGTH IN EXCESS OF 10 GPa. THESE GAUGES WILL HAVE A RISE TIME OF ABOUT 2  $\mu$ s OF DATA. DURING PHASE I, WE WILL CONSTRUCT AND CALIBRATE A STRESS-INDUCED BIREFRINGENCE GAUGE (SIBG) WHICH WOULD NEED NO ELECTRICAL CONDUCTORS IN OR NEAR THE CAVITY, RESULTING IN AN EMP-PROOF GAUGE. IN PHASE II, WE WOULD VALIDATE THE GAUGE WITH ABOVE GROUND TESTS AND FLASE X-RAY AND E-BEAM MACHINES ON HE EVENTS, AS DISTANT IMAGE. A FULL NUCLEAR AIRBLAST APPLICATION WOULD OCCUR ON DIAMOND FORTUNE AS PHASE II. THIS RESEARCH IS INNOVATIVE IN THAT WE WILL DEVELOP INSTRUMENTATION FOR MEASUREMENT OF AIRBLAST IN UNDERGROUND CAVITY HEIGHT-OF-BURST EVENTS. UNLIKE OTHER INSTRUMENTATION, THE OPTICAL HOPKINSON BAR WILL BE IMMUNE TO UPSET BY SOURCE REGION ELECTROMAGNETIC PULSE.

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**KTECH CORP**

901 PENNSYLVANIA AVE NE  
ALBUQUERQUE, NM 87110  
Program Manager: T J ROEMER

Contract #:

Title: NOVEL UNDERWATER SHOCK WAVE MEASUREMENT

Topic #: DNA90-005

Office: AM

ID #: 40079

THE PROPOSED EFFORT WILL DEVELOP AND APPLY A NEW EXPERIMENTAL APPROACH TO MEASURE UNDERWATER TIME RESOLVED SHOCK WAVE PROFILES RESULTING FROM UNDERWATER OR SURFACE DETONATIONS. EXPLICIT DATA REQUIRED TO DESCRIBE UNDERWATER SHOCK WAVE EFFECTS ON TARGETS WILL BE OBTAINED USING A RECENTLY DEVELOPED PIEZOELECTRIC POLYMER STRESS GAUGE. A UNIQUE EXPERIMENTAL CONFIGURATION IS PROPOSED, THAT WILL ALLOW SHOCK WAVE MEASUREMENTS IN THE 10(4) TO 10(10) Pa PRESSURE RANGE.

**PDA ENGINEERING**

2975 REDHILL AVE  
COSTA MESA, CA 92626

Program Manager: DR LARRY HARRAH

Contract #:

Title: A FIBER OPTIC DOSIMETER FOR MEASUREMENT OF NUCLEAR WEAPONS EFFECTS

Topic #: DNA90-005

Office: AM

ID #: 40084

FILMS OF RADIOCHROMIC DOSIMETRY MATERIAL COUPLED WITH FILTERS PROVIDE BOTH DOSE AND SPECTRAL INFORMATION ON NUCLEAR TESTS, A SUBSTANTIAL MONITORING CAPABILITY. THE DIAGNOSTIC DEVICES, HOWEVER, OCCUPY SUBSTANTIAL VOLUME; THE MATERIALS BLEACH DUE TO RADIATION DAMAGE AND ARE PRONE TO DYE MIGRATION. ALL CONSTITUTE SIGNIFICANT LIMITATIONS. A FIBER OPTIC DOSIMETER IS PROPOSED FOR UNDERGROUND NUCLEAR TESTS AND IN NUCLEAR WEAPON SIMULATION ENVIRONMENTS. THE DEVICE WILL OCCUPY AN EXTREMELY SMALL VOLUME OF TEST SPACE. MORE STABLE RADIOCHROMIC DYES ARE PROPOSED FOR INCORPORATION INTO THE OPTIC SENSOR. THE DIAGNOSTIC DEVICE WILL ALSO PROVIDE AN ACTIVE MEASUREMENT CAPABILITY. SPECIAL PHOTOCHROMIC DYE STRUCTURES WILL BE SYNTHESIZED. HOST POLYMERS, FOR THE PHOTOCHROMIC DYES, WILL BE PREPARED. DOSIMETRY MATERIALS, IN THIN FILM FORM, WILL BE SUBJECTED TO RADIATION EXPOSURE. ABSORPTION SPECTRUM, PRODUCT AGING AND COLORATION STABILITY MEASUREMENTS WILL ESTABLISH THE FEASIBILITY OF THE DEVICE CONCEPT. THE PRINCIPAL INVESTIGATOR IS THE DEVELOPER OF THE DOSIMETRY MATERIALS NOW EMPLOYED AT NTS. HE IS PRESENTLY INVESTIGATING FIBER OPTIC SENSORS FOR A VARIETY OF ENVIRONMENTS. THE PROPOSED PROGRAM BUILDS ON BOTH THESE AREAS OF EXPERTISE.

**TACAN CORP**

2330 FARADAY AVE  
CARLSBAD, CA 92008

Program Manager: DR KYUNG S LEE

Contract #:

Title: ULTRA-SENSITIVE OPTICAL FIBER MAGNETIC FIELD SENSOR

Topic #: DNA90-005

Office: AM

ID #: 40093

WE PROPOSE A PROTOTYPE ULTRA-SENSITIVE, FAST, COMPACT, AND RELIABLE FIBER OPTIC BASED MAGNETIC FIELD SENSOR PARTICULARLY SUITED FOR OPERATION IN ENVIRONMENTS APPROPRIATE FOR NUCLEAR WEAPON SIMULATION AND TESTING. THE DESIGN WILL TAKE ADVANTAGE OF AN INNOVATIVE WHICH WILL PERMIT REMOTE MEASUREMENTS OF MAGNETIC FIELDS WITH SIGNIFICANTLY ENHANCED

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DNA Solicitation 90.1

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SENSITIVITY AND RELIABILITY OVER PREVIOUS DEVICES. ALTHOUGH THE RECENT LABORATORY DEMONSTRATIONS OF FIBER OPTIC MAGNETIC FIELD SENSORS HAVE PROMISED UNIQUELY DISTINCT ADVANTAGES SUCH AS ELECTROMAGNETIC FIELD IMMUNITY, A NUMBER OF PROBLEMS HAVE RESTRICTED THEIR WIDE APPLICABILITY. WE PROPOSE A FIBER OPTIC MAGNETIC FIELD SENSOR BASED ON AN INNOVATIVE CONCEPT AND WHICH WILL TAKE ADVANTAGE OF OUR EXPERIENCE ACCUMULATED IN THE MANUFACTURABILITY OF OTHER FIBER OPTIC SENSORS AND HIGH DATA RATE COMMUNICATION LINKS. THE DESIGN WILL BE FOCUSED ON THE ASSEMBLY OF A DEVICE WHICH WILL BE INEXPENSIVE TO PRODUCE AND WILL HAVE HIGH SURVIVABILITY UNDER HOSTILE ENVIRONMENTS.

PHYSICON INC  
3325 TRIANA BLVD - STE A  
HUNTSVILLE, AL 35805  
Program Manager: DAVID B O'HARA  
Contract #:

Title: A DEVICE TO INCREASE THE SOFT X-RAY EXPOSURE AREA ON A UGT  
Topic #: DNA90-011                      Office: AM                      ID #: 40159

ON A HORIZONTAL LINE-OF-SIGHT UNDERGROUND NUCLEAR TEST (UGT), THE MAXIMUM AREA FOR EXPERIMENTS TO BE EXPOSED TO DIRECT SHINE FROM THE WORKING POINT IS THE STUB PLATE AREA. USUALLY, THE REQUESTS FOR EXPOSURE AREA ARE GREATER THAN THE AVAILABLE AREA. EXPERIMENTS INVOLVING SOFT X-RAYS HAVE TO BE PLACED IN A DIRECT LINE OF SIGHT BECAUSE SOFT X-RAYS SCATTER POORLY AND SOMETIMES HIGHER FLUENCES ARE REQUESTED THAN CAN BE PROVIDED BY SCATTERING. LARGE SCATTERERS ARE AVAILABLE FOR HARDER X-RAYS WHICH UTILIZE LARGE AREA LOW-Z SCATTERERS. THESE SCATTERERS EFFECTIVELY SHADOW LARGE AREAS FROM SOFT X-RAYS SO THEY REDUCE THE AREA AVAILABLE FOR SOFT X-RAY EXPERIMENTS. WE PROPOSE TO USE THE AREA IN FRONT OF THE HARD X-RAY SCATTERER TO DEPLOY A SOFT X-RAY REFLECTOR CONCENTRATOR WHICH WILL REFLECT SOFT X-RAYS INTO AN ALCOVE FOR EXPERIMENTS. THIS REFLECTOR WILL BE ESSENTIALLY TRANSPARENT TO HARD X-RAYS WHICH WILL PASS THROUGH TO THE SCATTERER BUT WILL PROVIDE HIGH REFLECTIVITY FOR SELECTED SOFT X-RAY ENERGIES. THIS WILL ALLOW AN EXPERIMENTER TO CUSTOM TAILOR HIS SOFT X-RAY SPECTRA WITHOUT INTERFERENCE FROM OTHER RADIATION AND WITHOUT USING VALUABLE EXPOSURE AREA.

TRANSDUCER RESEARCH INC  
1228 OLYMPUS DR  
NAPERVILLE, IL 60540  
Program Manager: JOSEPH R STETTER  
Contract #:

Title: CHEMICAL DETECTION CONSIDERATIONS IN TREATY VERIFICATION  
Topic #: DNA90-012                      Office: AM                      ID #: 40176

DURING THIS PHASE I, TRI WILL GATHER INFORMATION AND PRODUCE A DATA BASE AND BRIEFING (REPORT) TO BE DELIVERED TO THE DNA. THE MAJOR OBJECTIVE WILL BE TO ASSIST DNA IN EVALUATION, PLANNING, AND DEFINITION OF REQUIREMENTS FOR CHEMICAL ISSUES IN TREATY VERIFICATION. THE WORK WILL BE INTEGRATED WITHIN THE EXISTING PROGRAMMATIC FRAMEWORK. THESE DATA CAN BE USED TO DEFINE, EVALUATE, DETERMINE, SPECIFY, AND CATEGORIZE STATE-OF-THE-ART, OFF-THE-SHELF, AND EMERGING TECHNOLOGIES THAT MAY BE SUITABLE IN VERIFICATION SCENARIOS.

SMALL BUSINESS INNOVATION RESEARCH PROGRAM - PHASE I  
DNA Solicitation 90.1

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MISSION RESEARCH CORP  
PO DRAWER 719 - 735 STATE ST  
SANTA BARBARA, CA 93102  
Program Manager: BLAIR SAWYER

Contract #:

Title: AN NWE PROPAGATION SIMULATOR FOR HF TRANSCEIVERS

Topic #: DNA90-013

Office: AM

ID #: 40181

MISSION RESEARCH CORPORATION (MRC) PROPOSES TO BUILD HF-NEPS, AN HF CHANNEL SIMULATOR FOR BENCH-TOP TESTING OF HF TRANSCEIVERS. THE SIMULATOR WOULD DISTORT AND DELAY ANALOG HF SIGNALS AS IF THESE HAD PASSED THROUGH IONOSPHERIC REGIONS DISTURBED BY HIGH ALTITUDE NUCLEAR EXPLOSIONS. THE FREQUENCY SELECTIVE HF CHANNEL MODEL UNDERLYING THIS HARDWARE SIMULATOR WILL ACCOMMODATE THE HF CHANNEL SPECIFICATIONS CURRENTLY BEING DEFINED BY DNA/RAAE. THE SIMULATOR IS TO BE DEVELOPED IN TWO PHASES. UNDER PHASE I, TWO CRITICAL COMPONENTS OF THE SIMULATOR WILL BE BUILT AND TESTED IN PROTOTYPE FORM. PHASE I WILL ALSO ADDRESS THE FORMAL DOCUMENTATION OF THE SIMULATOR'S OVERALL DESIGN. THE SUCCESSFUL COMPLETION OF PHASE I WORK WILL EXPEDITE THE ACTUAL CONSTRUCTION OF THE SIMULATOR DURING PHASE II. HF-NEPS WILL PROVIDE A NEW AND IMPORTANT CAPABILITY TO THE MILITARY HF USER COMMUNITY.

PHYSICAL RESEARCH INC  
25500 HAWTHORNE BLVD - STE 2300  
TORRANCE, CA 90505

Program Manager: REZA TOOSI

Contract #: DNA001-90-C-0116

Title: APPLICATION OF BEAU GESTE DATA TO THE INTERPRETATION OF FIREBALL OPTICAL CHARACTERISTICS

Topic #: DNA90-013

Office: AM

ID #: 40186

OPTICAL EFFECTS OF NUCLEAR EXPLOSIONS, PARTICULARLY MULTIBURST INTERACTIONS AND INFRARED STRUCTURE DUE TO FIREBALL TURBULENCE, ARE OF CURRENT INTEREST. THE BEAU GESTE EXPERIMENT DATA BASE IS UNIQUE IN INCLUDING HOTWIRE ANEMOMETRY, IR VIDEO RECORD, AND VISIBLE LIGHT PHOTOGRAPHS FOR SINGLE AND MULTIPLE DETONATIONS. PRI PROPOSES TO DIGITIZE SELECTED IR, VISIBLE AND ANEMOMETRY DATA, OBTAIN POWER SPECTRAL DENSITIES (PSDs) AND PROBABILITY DENSITY FUNCTIONS (PDFs), AND ESTABLISH RELATIONSHIPS BETWEEN TURBULENCE STRUCTURE AND OBSERVED OPTICAL STRUCTURE. SCALING PROCEDURES WILL BE DEVELOPED, AND THE FEASIBILITY OF EXTENDING THE RELATIONSHIPS FROM SMALL-SCALE SIMULATIONS TO NUCLEAR DETONATIONS WILL BE INVESTIGATED.

SCIENCE RESEARCH LAB INC  
15 WARD ST  
SOMERVILLE, MA 02143  
Program Manager: DR STEPHEN F FULGHUM

Contract #:

Title: MULTI-BEAM LASER INTERFEROMETER FOR PLASMA DENSITY MEASUREMENTS IN A PLASMA EROSION OPENING SWITCH (PEOS)

Topic #: DNA90-015

Office: AM

ID #: 40212

SCIENCE RESEARCH LABORATORY PROPOSES TO DESIGN, CONSTRUCT AND TEST AN ULTRA-SENSITIVE LASER INTERFEROMETER TO MEASURE THE PLASMA DENSITY INSIDE A PLASMA EROSION OPENING SWITCH DURING ITS CONDUCTION AND OPENING PHASES. A SIMILAR INTERFEROMETER HAS ALREADY BEEN



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PROVEN BY SRL FOR ULTRA-SENSITIVE GAS ABSORPTION MEASUREMENTS. THE HIGHER BANDWIDTH REQUIRED FOR PEOS MEASUREMENTS AND THE MORE HOSTILE PULSED POWER ENVIRONMENT DEMAND A HIGHER POWER LASER, WHICH IS COMMERCIALY AVAILABLE. THE DENSITY MEASUREMENTS PROPOSED HERE, WITH MILLIMETER SPATIAL RESOLUTION AND NANOSECOND TEMPORAL RESOLUTION, WILL BE THE FIRST OF THEIR KIND IN TERA-WATT OPENING SWITCHES. BENCH TESTS OF FLASHBOARD PLASMAS WILL BE FOLLOWED BY FIELD TESTS ON A TERA-WATT CLASS OPENING SWITCH TEST-BED. MORE ACCURATE SCALING LAWS FOR HIGHER PERFORMANCE OPENING SWITCH DESIGNS WILL RESULT FROM THESE DETAILED TIME-RESOLVED DENSITY MEASUREMENTS. THIS PROJECT COULD HAVE MAJOR IMPACT ON THE DESIGN OF THE PROPOSED DECADE X-RAY SIMULATOR. THE INTERFEROMETER BUILT HERE CAN ALSO BE USED TO CHARACTERIZE PLASMA BLOW-OFF FROM ELECTRODE SURFACES IN OTHER REGIONS OF HIGH POWER ACCELERATORS FOR FREE ELECTRON LASERS, INERTIAL FUSION OR X-RAY SIMULATORS, SUCH AS MAGNETICALLY INSULATED TRANSMISSION LINES, PARTICLE BEAM DIODES AND X-RAY DIODES.

TETRA CORP

4905 HAWKINS ST NE

ALBUQUERQUE, NM 87109

Program Manager: WILLIAM M MOENY

Contract #:

Title: MOLECULARLY ENGINEERED POLYMERS WITH HIGH DIELECTRIC STORAGE DENSITY AND A LARGE DIELECTRIC CONSTANT

Topic #: DNA90-015

Office: AM

ID #: 40222

A SYNTHETIC PROGRAM IS PROPOSED TO ENGINEER POLYMER MATERIALS THAT HAVE A HIGH DIELECTRIC STORAGE DENSITY, LARGE DIELECTRIC CONSTANT, LOW DIELECTRIC DISSIPATION, AND LIGHT WEIGHT FOR PULSE FORMING LINES FOR PULSED POWER APPLICATIONS. THE SYNTHETIC PROGRAM WAS DEVELOPED BY CONSIDERING MATERIAL GUIDELINES WHICH INCLUDE: 1) INTRINSIC DIELECTRIC STRENGTH; 2) DIELECTRIC CONSTANT; 3) LOW DISSIPATION FACTORS; 4) PROCESSIBILITY; 5) ABILITY TO BE USED IN A BROAD RANGE OF AMBIENT CONDITIONS; AND 6) MECHANICAL STRENGTH. THE SYNTHESIZED POLYMERS WILL SUBSEQUENTLY BE FABRICATED INTO A UNIQUE MORPHOLOGY THAT ENHANCES THE UTILITY OF THESE MATERIALS. THE DIELECTRIC PROPERTIES OF THIS NOVEL MATERIAL/MORPHOLOGY SYSTEM WILL BE EVALUATED ON A LABORATORY SCALE AT HIGH VOLTAGE. DEVELOPMENT OF THIS TECHNOLOGY WOULD GREATLY REDUCE THE SIZE, WEIGHT AND COMPLEXITY OF PULSE POWER SYSTEMS. THE ANTICIPATED RESULTS OF PHASE I WILL BE MATERIALS CAPABLE OF PULSE VOLTAGES EXCEEDING 5 kV/mil (2MV/cm) AND WITH VERY HIGH DIELECTRIC ENERGY STORAGE DENSITIES AND HIGH DIELECTRIC CONSTANT.

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FOSTER-MILLER INC  
350 SECOND AVE  
WALTHAM, MA 02254

Program Manager: HANS A HUG

Contract #:

Title: ELECTROMECHANICAL POWER FOR ELECTRONICS

Topic #: DARPA90-001

Office:

ID #: 50348

TECHNICAL ABSTRACT - MAN-PORTABLE ELECTRONICS EQUIPMENT SUCH AS THE MINI GLOBAL POSITIONING SYSTEM RECEIVER IS CURRENTLY POWERED BY HEAVY CHEMICAL BATTERIES. A WIND-UP SPRING DEVICE, CAPABLE OF PRODUCING 4W AT 12V FOR 5 MIN AT ONE WINDING, WOULD BE A DESIRABLE SUBSTITUTE FOR BATTERIES. UNFORTUNATELY, CALCULATIONS SHOW THAT THE WEIGHT AND BULK OF A SPRING MECHANISM WOULD BE UNACCEPTABLE. INSTEAD, A SMALL, HIGHLY EFFICIENT FLYWHEEL AND GENERATOR COMBINATION IS PROPOSED. THE PROPOSED SYSTEM WEIGHS APPROXIMATELY 5 LB AND IS ABOUT 6 IN. IN THE LONGEST DIMENSION. THE FLYWHEEL, WHICH ROTATES IN A CHAMBER THAT IS EVACUATED AUTOMATICALLY WHEN THE FLYWHEEL IS SPUN UP MANUALLY, STORES MORE THAN ENOUGH ENERGY TO MEET SPECIFICATIONS. THE SYSTEM IS RELIABLE, RUGGED, AND CAPABLE OF BEING "RECHARGED" IN THE FIELD INDEFINITELY. IN ADDITION, IT INCORPORATES STANDBY MEASURES WHICH MAKE THE SYSTEM READY FOR INSTANT USE WITH NO WAITING WHATSOEVER. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - MANY MILITARY AND COMMERCIAL PORTABLE ELECTRONIC DEVICES ARE DRIVEN BY BATTERIES THAT ARE EXCESSIVELY HEAVY, SO AS TO ASSURE ENOUGH ENERGY FOR EXTENDED-RANGE OPERATIONS. THE PROPOSED ELECTROMECHANICAL POWER SUPPLY AND ITS FUTURE DERIVATIVES CAN PERFORM THE SAME FUNCTION WITH MUCH LESS WEIGHT AND BULK. KEY WORDS - FLYWHEEL, GENERATOR, ELECTROMECHANICAL POWER SUPPLY, ENERGY STORAGE, BATTERY

INNOVATIVE SCIENCES, INC.  
400 HESTER STREET

SAN LEANDRO, CA 94577

Program Manager: BRUCE MAXFIELD

Contract #:

Title: ELECTROMECHANICAL POWER SUPPLIES

Topic #: DARPA90-001

Office:

ID #: 50469

TECHNICAL ABSTRACT - THIS PROPOSAL OUTLINES SEVERAL POSSIBLE APPROACHES TO THE DEVELOPMENT OF ELECTRICAL POWER SUPPLIES THAT DERIVE THEIR PRIMARY ENERGY FROM STORED MECHANICAL ENERGY. IN GENERAL, IT IS ENVISIONED THAT THESE MECHANICAL ENERGY STORAGE SYSTEMS (SPRINGS AND GAS RESERVOIRS) WILL BE CHARGED USING EITHER HUMAN-OPERATED "PUMPS" OR INCIDENTAL MECHANICAL ENERGY THAT MAY BE AVAILABLE ABUNDANTLY BUT IN A "LOW-QUALITY" FORM. IT IS ARGUED THAT AT LEAST FOUR APPROACHES SHOULD BE ABLE TO MEET THE 4 WATT/5 MINUTE POWER/ENERGY REQUIREMENTS FOR A WIND-UP BATTERY AND AT LEAST ONE OF THESE APPROACHES WILL PERMIT ONE OR MORE ORDERS OF MAGNITUDE INCREASE IN THE AVAILABLE ELECTRICAL ENERGY. IN ORDER TO ADD ADDITIONAL CREDIBILITY TO THESE PROJECTIONS, RESULTS OF MEASUREMENTS ON TWO SYSTEMS ARE PRESENTED. ONE USES A LOW PRESSURE RADIAL OUTFLOW AIR TURBINE TO DRIVE A HIGH SPEED IRONLESS DC GENERATOR AND THE OTHER USES A HIGH PRESSURE AIR TURBINE TO DRIVE AN AXIAL GAP, 3 PHASE AC GENERATOR. IT IS ALSO ARGUED THAT A RESONANT PIEZOELECTRIC GENERATOR SHOULD BE ABLE TO MEET THE NECESSARY POWER/ENERGY REQUIREMENTS. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - THESE ELECTROMECHANICAL POWER SUPPLIES WILL REDUCE THE TOTAL WEIGHT NEEDED FOR POWERING ELECTRICAL SYSTEMS HAVING ONLY MODEST ENERGY REQUIREMENTS BY ELIMINATING THE NEED TO CARRY MULTIPLE SETS OF CHEMICAL BATTERIES ON EXTENDED MISSIONS. THESE POWER SUPPLIES WILL OPERATE UNDER CONDITIONS OF EXTREME COLD, HIGH HUMIDITY OR HIGH TEMPERATURE. THEY WILL HAVE ADVANTAGES FOR COMMERCIAL APPLICATIONS WHEREVER LONG SHELF LIFE IS OF PRIME IMPORTANCE. KEY WORDS -

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ELECTROMECHANICAL, GAS STORAGE, SPRINGS, PIEZOELECTRIC, GENERATORS, HIGH PRESSURE.

ELECTRIC PROPULSION LABORATORY INC.  
440 NORTH GREEN STREET  
TEHACHAPI, CA 93561

Program Manager: GRAEME ASTON

Contract #:

Title: AN ELECTROSTATIC PLASMA ACCELERATOR PROPULSION SYSTEM FOR SMALL SATELLITES

Topic #: DARPA90-004

Office:

ID #: 50454

TECHNICAL ABSTRACT - A SIMPLE, HIGH SPECIFIC IMPULSE ELECTRIC PROPULSION THRUSTER IS PROPOSED FOR APPLICATION TO SMALL SATELLITES. THIS THRUSTER USES AN ELECTROSTATIC PLASMA ACCELERATION (EPA) PRINCIPLE TO ACHIEVE PROJECTED SPECIFIC IMPULSE LEVELS OF ORDER 1,000 SEC. KEY FEATURES OF THE EPA THRUSTER CONCEPT INCLUDE THE ABILITY TO OPERATE DIRECTLY OFF THE SPACECRAFT BUS, WITH LITTLE OR NO POWER CONDITIONING, AND THE CAPABILITY OF OPERATING WITH A VARIETY OF PROPELLANTS INCLUDING INERT GASES AND HYDRAZINE DECOMPOSITION PRODUCTS. CALCULATIONS ARE PRESENTED WHICH SHOW THAT THE MISSION CAPABILITY OF SMALL SATELLITES WOULD BE SIGNIFICANTLY EXPANDED BY THE USE OF AN EPA PROPULSION SYSTEM. A JOINT PHASE I PROGRAM BETWEEN THE ELECTRIC PROPULSION LABORATORY AND THE UNIVERSITY OF TENNESSEE SPACE INSTITUTE, CENTER FOR ADVANCED SPACE PROPULSION, IS PROPOSED TO INVESTIGATE EPA THRUSTER OPERATION AT POWER LEVELS UP TO A FEW HUNDRED WATTS AND THE INTEGRATION ISSUES ATTENDANT TO ADAPTING THIS PROPULSION CONCEPT TO SMALL SATELLITES. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - THE EPA THRUSTER CONCEPT OFFERS A SIMPLE, LOW COST, HIGH SPECIFIC IMPULSE PROPULSION SYSTEM WHICH CAN LOWER THE LAUNCH AND MAINTENANCE COSTS OF SMALL SATELLITES BY INCREASING PAYLOAD, ON-STATION LIFETIME AND MISSION MANEUVERING CAPABILITY. THESE POTENTIAL BENEFITS WOULD ENHANCE THE MISSION SERVICES OFFERED BY COMMERCIAL LAUNCH VEHICLE COMPANIES. KEY WORDS - ELECTROSTATIC PLASMA ACCELERATOR PROPULSION SMALL SATELLITE.

DYNATHERM CORPORATION  
ONE BEAVER COURT  
COCKEYSVILLE, MD 21030

Program Manager: DAVID WOLF

Contract #:

Title: EVALUATION OF THERMAL CONTROL CONCEPTS FOR SMALL SATELLITES

Topic #: DARPA90-005

Office:

ID #: 50451

TECHNICAL ABSTRACT - THIS PROPOSAL IS SUBMITTED JOINTLY BY DYNATHERM AND ITS AFFILIATE THERMACORE. A STUDY IS PROPOSED THAT WILL EVALUATE SEVERAL THERMAL CONTROL CONCEPTS FOR SMALL SATELLITES WITH A NOMINAL THERMAL DISSIPATION OF 1 KW. FIVE CONCEPTS HAVE BEEN IDENTIFIED IN THE PROPOSAL: DEPLOYABLE RADIATORS, THERMAL STORAGE, HEAT PUMPS, VARIABLE CONDUCTANCE HEAT PIPES AND INTEGRATED STRUCTURAL HEAT PIPES. EACH CONCEPT WILL BE EVALUATED AGAINST THE REQUIREMENTS TO BE DEFINED JOINTLY WITH DARPA AND SATELLITE MANUFACTURERS/INTEGRATORS. CRITICAL TECHNOLOGIES WILL BE IDENTIFIED AND BREADBOARD EXPERIMENTS OF CRITICAL COMPONENTS WILL BE PERFORMED. A PRELIMINARY DESIGN AND PERFORMANCE ANALYSIS WILL BE GENERATED FOR THE MOST PROMISING CONCEPT. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - THE TECHNOLOGIES IDENTIFIED IN THE PROPOSAL HAVE APPLICATIONS IN NASA MISSIONS AND COMMERCIAL COMMUNICATION SATELLITES. DEPLOYABLE RADIATORS AND THE REQUIRED FLEXIBLE JOINTS ARE OF INTEREST TO SDIO BECAUSE THEY CAN BE PROTECTED AGAINST EXTERNAL THREATS. KEY WORDS - RADIATORS, HEAT PIPES, FLEXIBLE JOINTS, THERMAL STORAGE, COLD PLATES, HEAT PUMPS.

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MISSION RESEARCH CORP.  
1720 RANDOLPH ROAD, SE  
ALBUQUERQUE, NM 87106  
Program Manager: CHERLY WHITE  
Contract #:

Title: HIGH POWER DEMONSTRATION OF A NOVEL BLUE-GREEN SEMICONDUCTOR LASER FOR TACTICAL AIRBORNE LASER COMMU

Topic #: DARPA90-008

Office:

ID #: 50477

TECHNICAL ABSTRACT - MISSION RESEARCH CORPORATION PROPOSES A NOVEL SEMICONDUCTOR LASER FOR TACTICAL AIRBORNE LASER COMMUNICATIONS. THE APPROACH INVOLVES A VERTICAL CAVITY, SURFACE EMITTING LASER WITH A RESONANT PERIODIC GAIN (RPG) MEDIUM WHICH IS A UNIQUE QUANTUM WELL CONFIGURATION. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - DEMONSTRATION OF A SIMPLE SEMICONDUCTOR LASER SYSTEM WHICH CAN BE DESIGNED AROUND ANY CENTER WAVELENGTH IN THE OCEANIC WINDOW (400-550 NM) EXHIBITS LONGITUDINAL MODE SELECTIVITY AND IS SCALABLE TO HIGH POWER. KEY WORDS - HIGH POWER SEMICONDUCTOR LASER, BLUE-GREEN, SURFACE-EMITTER.

OPTELECOM, INC.  
15930 LUANNE DRIVE  
GAITHERSBURG, MD 20877  
Program Manager: RONALD SMITH  
Contract #:

Title: COIL WINDING MACHINERY FOR INTERFEROMETRIC FIBER OPTIC GYRO MANUFACTURABILITY

Topic #: DARPA90-009

Office:

ID #: 50479

TECHNICAL ABSTRACT - INTERFEROMETRIC FIBER OPTIC GYRO (IFOG) OPTICAL FIBER COIL WINDINGS ARE PRECISION LEVEL WINDINGS BETWEEN FLANGES. TO MAKE THESE WINDINGS INSENSITIVE TO THERMAL GRADIENTS ACROSS THE WOUND PACK, THE INNERMOST WOUND LAYERS IS AT THE CENTER OF THE MEASUREMENT PATH FIBER COIL. ALTERNATE PAIRS OF SUBSEQUENT LAYERS ARE DRAWN FROM LENGTHS OF FIBER ON OPPOSITE SIDES OF THE CENTER INNERMOST LAYER. THIS ARRANGEMENT CAUSES ANY THERMAL GRADIENT PRESENT IN THE COIL STRUCTURE TO BE SYMMETRICAL ABOUT THE CENTER OF THE FIBER LOOP, WITH THE RESULT THAT MEASUREMENT ERRORS FROM THE TWO HALVES OF THE LOOP CANCEL ONE ANOTHER. ALTHOUGH THE PRINCIPLE IS SOUND, SUCH WINDINGS ARE DIFFICULT TO REALIZE IN PRACTICE, BECAUSE THE ALTERNATING LAYER PAIR GEOMETRY TENDS TO INTRODUCE WINDING FLAWS WHICH DEGRADE PRECISION AND MAKE RELIABLE PRODUCTION OF THE WINDING DIFFICULT. OPTELECOM HAS DEvised PROPRIETARY METHODS OF LEVEL WINDING BETWEEN FLANGES WHICH FACILITATE MAINTAINING THE REQUIRED PRECISION. WE PROPOSE TO SHOW HOW THESE PROPRIETARY WINDING TECHNIQUES WILL LEAD TO A LOW MANUFACTURING COST IFOG COIL WINDING IMPLEMENTATION. IN PHASE I, WE PROPOSE TO DEMONSTRATE THE WINDING IMPLEMENTATION USING PROTOTYPE MACHINERY. IN PHASE II, WE PLAN TO DEVELOP A WINDING MACHINE CAPABLE OF MAKING 1,000 COILS PER YEAR. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - WINDING COST ALONE FOR IFOG COILS IS PRESENTLY \$1,000 PER AXIS OR MORE. THIS IS THE SINGLE LARGEST COST ELEMENT OF IFOG SYSTEMS. IF SUCCESSFUL, THE PROPOSED WORK COULD REDUCE WINDING COST TO LESS THAN \$200.00 PER AXIS. IFOG UNITS WILL HAVE WIDESPREAD MILITARY APPLICATIONS. IN ADDITION, CERTAIN COMMERCIAL APPLICATIONS SUCH AS USE FOR INDUSTRIAL ROBOTICS AND RECREATIONAL MARINE NAVIGATION WILL BECOME FEASIBLE. KEY WORDS - FIBER OPTIC GYRO COILS, FIBER COIL WINDING MACHINERY.

PRINCETON COMBUSTION RSCH LABS INC  
4275 US HWY 1  
MONMOUTH JUNCTION, NJ 08852  
Program Manager: DR JEFFREY K OKAMITSU

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DARPA Solicitation 90.1

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Contract #:

Title: REDUCTION OF SPECTRAL SIGNATURE OF JET ENGINE BY MEANS OF CATALYTIC COMBUSTION

Topic #: DARPA90-010

Office:

ID #: 50378

TECHNICAL ABSTRACT - THE OBJECTIVE IS TO FIND A TECHNICAL MEANS TO REDUCE THE SPECTRAL SIGNATURE OF AIRBORNE JET-PROPELLED VEHICLES, SUCH AS CRUISE MISSILES AND MANNED AIRCRAFT. INASMUCH AS MODERN TECHNIQUES CAN BE EMPLOYED TO REDUCE GREATLY THE RADAR SIGNATURES OF THE AIRFRAME, THIS INVESTIGATION IS FOCUSED ON THE PRINCIPAL REMAINING SIGNATURE SOURCE, I.E., THE HOT JET. THE EXHAUST JET OF A CONVENTIONAL ENGINE CONTAINS A SIGNIFICANT CONCENTRATION OF NON-EQUILIBRIUM EMITTERS, IONS AND RADICALS, THAT CAN RADIATE IN THE INFRARED AND THE VIS-UV SPECTRAL REGIONS. THIS OCCURS BECAUSE COMBUSTION IN ALL SUCH ENGINES TAKES PLACE VIA A TWO-STAGE PROCESS, A HOT PRIMARY STAGE (3500 F) WITH A FUEL-AIR RATIO DESIGNED TO PROVIDE EASY IGNITION AND PREVENT BLOWOUT, AND THEN A SECOND STAGE WITH AIR-DILUTION DESIGNED TO MAKE THE GAS TEMPERATURE ACCEPTABLE TO THE TURBINE, ABOUT 1600-1800 F. AN ALTERNATIVE IS THE CATALYTIC COMBUSTOR, WHICH HAS BEEN SHOWN TO BURN READILY THE VERY LEAN FUEL-AIR MIXTURES CORRESPONDING TO TEMPERATURES OF 1600-1800 F, OR EVEN LESS. AT SUCH LOW TEMPERATURES, THERE IS EVIDENCE THAT NON-EQUILIBRIUM EMITTERS ARE NOT PRODUCED SIGNIFICANTLY, AND THEREFORE, THAT SIGNATURES WOULD BE REDUCED. THE PROPOSED RESEARCH PROJECT IS INTENDED TO EXPLORE BOTH THEORETICALLY, AND BY COMPARISON EXPERIMENTALLY BETWEEN CONVENTIONAL-TYPE AND CATALYTIC-TYPE COMBUSTORS, THE EXTENT OF SUCH SIGNATURE REDUCTION IN THE SPECTRAL RANGE FROM ABOUT 3000 A.U. TO ABOUT 9,000 A.U. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - THIS MODE OF COMBUSTION IN A JET ENGINE, IF SUCCESSFUL, WOULD OFFER A RADICAL REDUCTION OF JET SIGNATURE, AND IN ADDITION, A SHARP REDUCTION OF SUCH NONEQUILIBRIUM POLLUTANTS AS NOX AND SOX. IT IS RECOGNIZED THAT THERE ARE OTHER PRACTICAL ATTRIBUTES THAT MUST BE RESOLVED BEFORE A CATALYTIC COMBUSTOR IS ACCEPTED AS A SUBSTITUTE FOR A CONVENTIONAL TYPE, BUT THE PAYOFF COULD BE LARGE. THE JET ENGINE INDUSTRY MIGHT HAVE TO UNDERGO A MAJOR CHANGE, IF THE RESULT IS PERSUASIVE.

JAMAR TECHNOLOGY CO.

3956 SORRENTO VALLEY BOULEVARD, SUITE D

SAN DIEGO, CA 92121

Program Manager: HARRY SHIELDS

Contract #:

Title: IMAGING SENSOR FOR RELOCATABLE TARGET SENSOR TECHNOLOGY

Topic #: DARPA90-012

Office:

ID #: 50472

TECHNICAL ABSTRACT - A PROGRAM IS PROPOSED TO EVALUATE THE FEASIBILITY OF USING LASER-INDUCED FLUORESCENCE AS A MEANS OF DETECTING MILITARY TARGETS. TARGET IDENTIFICATION WILL BE ACHIEVED BY USING AN INTENSIFIED VIDEO CAMERA TO CAPTURE FLUORESCENCE IMAGES GENERATED WHEN A UV LASER ILLUMINATES THE TARGET FIELD. THE PHASE I PROGRAM WILL ADDRESS THE LASER TRANSMITTER, RECEIVER, VIDEO CAMERA, IMAGE PROCESSING AND SYSTEM INTEGRATION ISSUES LEADING TO A CONCEPTUAL SYSTEM DESIGN. THE SENSOR WILL BE BASED ON AN EXISTING ADVANCED COMPACT EXCIMER LASER (ACEL) WHICH JAMAR TECHNOLOGY CO. HAS DEVELOPED FOR AIRBORNE APPLICATIONS. THE ACEL LASER IS A XECL DEVICE, OPERATING AT 308 NM, AND WILL BE THE TRANSMITTER OF THE PROPOSED SYSTEM. STUDIES OF LASER-INDUCED FLUORESCENCE FROM LABORATORY SAMPLES WILL BE CARRIED OUT TO CHARACTERIZE FLUORESCENCE SPECTRA AND EFFICIENCY. THIS DATA WILL BE INCLUDED IN A SIGNAL-TO-NOISE MODEL WHICH WILL PREDICT THE EXPECTED IMAGING PERFORMANCE OF THE SENSOR AS A FUNCTION OF SYSTEM PARAMETERS AND TARGET RANGE. THE SIGNAL-TO-NOISE MODEL PREDICTIONS WILL BE THE PRIMARY CRITERION TO ESTABLISH FEASIBILITY OF THE PROPOSED IMAGING SENSOR. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - THE PROPOSED RESEARCH WILL LEAD TO A NEW CAPABILITY IN IMAGING OF FLUORESCENT RETURNS FROM MILITARY AND COMMERCIAL TARGETS. EXAMPLES INCLUDE MILITARY VEHICLES EMITTING HYDROCARBON EXHAUST FUMES, TOXIC OR ENVIRONMENTALLY HAZARDOUS GASES, OIL SLICKS ON OCEANS, VEGETATION (INCLUDING NARCOTIC CULTIVATION), ETC. KEY WORDS -

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LASER-INDUCED FLUORESCENCE, IMAGING SENSOR, UV LASERS.

MARK RESOURCES, INC.  
2665 30TH STREET, SUITE 200  
SANTA MONICA, CA 90405  
Program Manager: AUGUST RIHACZEK  
Contract #:  
Title: RELOCATABLE TARGET SENSOR TECHNOLOGY  
Topic #: DARPA90-012                      Office:                      ID #: 50475

TECHNICAL ABSTRACT - FOR THE PAST EIGHT YEARS WE HAVE BEEN DEVELOPING AN EXTENSION OF RADAR RESOLUTION THEORY TO THE PECULIAR BACKSCATTERING PROPERTIES OF MAN-MADE TARGETS, AND WE HAVE ALSO DEVELOPED THE SIGNAL PROCESSING TECHNOLOGY NEEDED TO IMPLEMENT THIS ADVANCED THEORY. ALTHOUGH THIS TECHNOLOGY, WHICH IS CALLED ADAPTIVE SCATTERER MEASUREMENTS (ASM) PROCESSING, HAS BEEN DIRECTED PRIMARILY TO THE IDENTIFICATION OF STATIONARY GROUND VEHICLES, AND RECENTLY TO THE IDENTIFICATION OF NONMANEUVERING AIRCRAFT, IT IS MORE GENERALLY APPLICABLE TO ALL TYPES OF RADAR MEASUREMENTS ON MAN-MADE TARGETS. IN MANY TESTS ON REAL DATA WE HAVE DEMONSTRATED THAT ASM IS ABLE TO EXTRACT MUCH MORE INFORMATION ABOUT THE TARGET THAN WHAT IS POSSIBLE WITH THE MORE CONVENTIONAL TECHNIQUES, SUCH AS AN ACCURATE TARGET OUTLINE AND THE LOCATION OF NUMEROUS FEATURES ON THE TARGET. WE ARE PROPOSING TO APPLY THIS NEW PROCESSING TECHNOLOGY TO THE PROBLEM OF DETECTING SRTS, WHICH IS BASICALLY A PROBLEM OF DISCRIMINATING SRTS FROM NATURAL AND MAN-MADE CLUTTER. THE PRINCIPAL OBJECTIVE IN PHASE I IS TO DEMONSTRATE THE ACHIEVABLE PERFORMANCE ON REAL DATA. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - THE PROPOSED RESEARCH WILL BE OF CONSIDERABLE BENEFIT TO THE GOVERNMENT BECAUSE IT WILL LEAD TO MORE POWERFUL METHODS FOR TARGET DISCRIMINATION, AND FOR IDENTIFYING ALL TYPES OF TARGETS IN GENERAL. THERE APPEARS TO BE NO COMMERCIAL APPLICATION FOR THIS RESEARCH. KEY WORDS - DETECTION OF RELOCATEABLE TARGETS; HIGH-RESOLUTION RADAR.

AURORA FLIGHT SCIENCES CORPORATION  
P.O. BOX 11998  
ALEXANDRIA, VA 22312  
Program Manager: JOHN LANGFORD  
Contract #:  
Title: LOW-COST FUEL CELL PROPULSION SYSTEM FOR UNMANNED AIRCRAFT  
Topic #: DARPA90-014                      Office:                      ID #: 50437

TECHNICAL ABSTRACT - A FUEL-CELL BASED PROPULSION SYSTEM FOR SUBSONIC HIGH-ALTITUDE, LONG-ENDURANCE UNMANNED AIRCRAFT IS PROPOSED. BY UTILIZING THE AURORA PERSEUS, AN EXISTING RPV ALREADY DESIGNED FOR HIGH-ALTITUDE FLIGHT USING ELECTRIC PROPULSION, AND A 10 KW SOLID POLYMER ELECTROLYTE FUEL CELL ALREADY UNDER DEVELOPMENT FOR DARPA USE IN UNMANNED UNDERWATER VEHICLES, THIS PROPOSAL OFFERS A LOW-COST, NEAR-TERM OPPORTUNITY FOR FLIGHT DEMONSTRATION. SUCH A DEMONSTRATION IS IMPORTANT BECAUSE, ALTHOUGH THE POTENTIAL OF FUEL CELLS AS AN AIRCRAFT PROPULSION MEANS HAS BEEN SUGGESTED BY SEVERAL PREVIOUS STUDIES, THE RELATIVELY HIGH COSTS OF DEVELOPING A DEDICATED SYSTEM HAVE TO DATE IMPEDED PROGRESS. FUEL CELL PROPULSION OFFERS NUMEROUS POTENTIAL ADVANTAGES TO BOTH MILITARY AND NON-MILITARY AIRCRAFT BECAUSE THEIR HIGH EFFICIENCY, LACK OF EFFLUENTS, AND LOW OPERATING TEMPERATURES GIVE THEM THE POTENTIAL FOR LONG ENDURANCE AND LOW OBSERVABLES. FURTHER, THE ABILITY TO OPERATE ON EITHER AMBIENT AIR OR STORED OXIDIZER GIVES THEM THE CAPABILITY FOR SUBSONIC OPERATION AT ALTITUDES CONSIDERABLY EXCEEDING 100,000 FEET. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - AMONG THE MANY POSSIBLE APPLICATIONS OF THIS TECHNOLOGY ARE THE JPO'S "ENDURANCE" CLASS OF UAVS OR THE NASA HIGH-ALTITUDE RESEARCH PLATFORM (HARP). KEY WORDS - FUEL CELLS, ELECTRIC PROPULSION, UNMANNED AIRCRAFT.

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ENERGY CONVERSION DEVICES, INC

1675 WEST MAPLE ROAD

TROY, MI 48084

Program Manager: WOLODYMYR CZUBATYJ

Contract #:

Title: DEVELOPMENT OF THRESHOLD SWITCHES FOR PROTECTION OF ELECTRO-OPTIC AND INFRARED SENSORS

Topic #: DARPA90-017

Office:

ID #: 50455

TECHNICAL ABSTRACT - HIGH POWER MICROWAVE ENERGY CAN OVERLOAD AND DAMAGE ELECTRO-OPTIC AND INFRARED SENSORS, WHICH ARE THE "EYES" OF MODERN WEAPON SYSTEMS. THE PROPOSED PROGRAM WILL DEVELOP AND INVESTIGATE THE APPLICABILITY OF THE CHALCOGENIDE THRESHOLD SWITCH AS A PROTECTOR FOR ELECTRO-OPTIC INFRARED SENSORS. BY PLACING THE SWITCH ACROSS THE SENSOR TERMINALS, IT WILL REACT VERY RAPIDLY TO EXCESS VOLTAGES AND SHUNT THEM TO GROUND, THEREBY PROTECTING THE SENSORS FROM OVERLOAD AND PROBABLE DAMAGE. THE THRESHOLD SWITCH HAS ALREADY BEEN SHOWN TO BE FAST AND POWERFUL ENOUGH TO ACT AS A TRANSIENT EMP PROTECTOR FOR RF APPLICATIONS. THIS PROGRAM WOULD DESIGN, FABRICATE AND TEST THE SWITCH AS A PROTECTOR AGAINST HIGH POWER MICROWAVE ENERGY. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - SUCCESSFUL DEMONSTRATION OF THE THRESHOLD SWITCH PROTECTORS FOR ELECTRO-OPTIC AND INFRARED SENSORS WILL NOT ONLY LEAD TO MILITARY USE FOR WEAPONS SYSTEMS BUT ALSO TO COMMERCIAL APPLICATIONS IN SATELLITE AND FIBER OPTIC COMMUNICATIONS. KEY WORDS - MICROWAVE PROTECTORS, THRESHOLD SWITCH, VOLTAGE CLAMPS.

CENTER FOR REMOTE SENSING

P.O. BOX 9244

MCLEAN, VA 22102

Program Manager: SUMAN GANGULY

Contract #:

Title: DESIGN OF A COMPACT HELICAL TYPE ANTENNA

Topic #: DARPA90-021

Office:

ID #: 50441

TECHNICAL ABSTRACT - WE PROPOSE TO DESIGN AND DEVELOP A HELIX BASED ANTENNA WITH BEAMWIDTH OF THE ORDER OF 10 DEGREES AND WITH POWER HANDLING CAPABILITY OF HUNDREDS OF MW. THE HELICAL ANTENNA CAN BE WOUND LIKE A SPRING AND THUS FIT EASILY INSIDE A CANNON SHELL. WHEN DEPLOYED, THE SPRING ACTION WILL AUTOMATICALLY BRING IT TO ITS PREDETERMINED UNWOUND CONFIGURATION. THE HELIX CAN BE WOUND WITH WIRES OR SUITABLE TAPES. PHASE I DESIGN STUDY IS TO DESIGN THE ELECTRICAL AND MECHANICAL CHARACTERISTICS OF THE ANTENNA. NUMERICAL MODELLING CODE WILL BE USED FOR ESTIMATING THE PERFORMANCE OF THE ANTENNA. PHASE I DELIVERABLE IS A COMPLETE DESIGN STUDY, ELECTRICAL AND MECHANICAL DESIGN OF THE ANTENNA AND ITS PREDICTED PERFORMANCE. A PROTOTYPE WILL BE CONSTRUCTED DURING PHASE II AND TESTED USING THE ANTENNA AND MECHANICAL TEST FACILITIES AVAILABLE WITH MAJOR CONTRACTORS. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - THERE IS AN IMMEDIATE NEED BY THE DOD COMPONENTS FOR THE SPECIFIC SOLICITATION. SEVERAL SPIN-OFF ACTIVITIES WILL RESULT FROM THIS EFFORT WHICH HAVE LARGE SCALE DOD AND COMMERCIAL APPLICATION. KEY WORDS - COMPACT ANTENNA, HELICAL ANTENNA.

DEFENSE ELECTROMAGNETIC ANALYSIS COMPANY

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Program Manager: SHUNG-WU LEE

Contract #:

Title: A COMPACT & DEPLOYABLE HIGH POWER MICROWAVE ANTENNA

SMALL BUSINESS INNOVATION RESEARCH PROGRAM - PHASE I  
DARPA Solicitation 90.1

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Topic #: DARPA90-021

Office:

ID #: 50449

TECHNICAL ABSTRACT - WE PROPOSE TO STUDY THE ELECTROMAGNETIC AND THE MECHANICAL ASPECTS OF A COLLAPSIBLE REFLECTOR ANTENNA FOR HIGH POWER MICROWAVE APPLICATION. THE REFLECTOR SURFACE IS MADE OF A THIN, FLEXIBLE, INEXTENSIBLE MEMBRANE OF PARABOLIC SHAPE WITH 1 METER DIAMETER. IT IS FOLDED TOGETHER WITH A CONTOUR RING MUCH LIKE A PARACHUTE CANAPE AND WRAPPED AROUND AN OPEN-ENDED CIRCULAR WAVEGUIDE FEED. THE CALCULATED ANTENNA DIRECTIVITY IS 24 DB, AND ITS 3 DB BEAMWIDTH IS 60, WHICH CORRESPONDS TO A FOOT-PRINT OF 13 SQUARE METERS WHEN THE ANTENNA IS FIRED AT A HEIGHT OF 20 METERS ABOVE THE GROUND. WE SHALL ALSO LOOK INTO THE FEASIBILITY OF A "SMART" VERSION THAT CAN FACILITATE SEARCH, LOCK-IN AND GUIDANCE CAPABILITIES NECESSARY FOR A MORE ACTIVE PURSUIT OF A TARGET. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - THE PROPOSED ANTENNA IS SIMPLE AND INEXPENSIVE. ITS REALIZATION APPEARS TO BE WITHIN THE CURRENT TECHNOLOGY. WITHIN SOME ADDED "SMARTNESS," IT HAS THE POTENTIAL TO BE AN EFFECTIVE DELIVERY DEVICE OF HPM. WE OFFER TO STUDY THIS PROBLEM BY TWO FOREMOST AUTHORITIES IN THIS FIELD AND ANTICIPATE TO ARRIVE AT A DEFINITIVE CONCLUSION ON ITS FEASIBILITY WITHIN 6 MONTHS. KEY WORDS - HIGH POWER MICROWAVE, REFLECTOR ANTENNA, DEPLOYABLE REFLECTOR

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Contract #:

Title: A HIGH CURRENT LONG PULSE REP. RATEABLE RF ELECTRON GUN

Topic #: DARPA90-022

Office:

ID #: 50461

TECHNICAL ABSTRACT - A NOVEL ELECTRON GUN CAPABLE OF PRODUCING A CURRENT DENSITY OF SEVERAL HUNDRED AMPERES/CM<sup>2</sup> AT 10 KHZ, WITH NANOSECOND TO SEVERAL HUNDRED NANOSECOND LONG PULSES IS PROPOSED. THE CONCEPT IS BASED ON MULTIPACTING ELECTRONS IN AN RF CAVITY, WHERE ONE WALL OF THE CAVITY IS PARTIALLY TRANSPARENT TO ELECTRONS. THE TRANSPARENT WALL ALLOWS FOR THE TRANSMISSION OF THE OUTPUT BEAM AT A LOW RF VOLTAGE (< 20 KV), AND CAN SERVE AS A CATHODE FOR A FEW MEV BEAM ACCELERATOR. THIS MECHANISM AVOIDS THE DIFFICULTIES ASSOCIATED WITH PLASMA CATHODES, THERMIONIC EMITTERS AND FIELD EMISSION CATHODES. PLASMA CATHODES CANNOT BE REP-RATED AT 10 KHZ, NOR CAN THEY SUSTAIN VERY LONG PULSES WITHOUT COLLAPSING THE VOLTAGE. THERMIONIC EMITTERS ARE ONLY GOOD FOR LOW CURRENT DENSITIES (< 20 AMPS/CM<sup>2</sup>), AND CAN AND ARE EASILY CONTAMINATED. FIELD EMISSION CATHODES REQUIRE A HUGH FIELD OF 4000MV/M TO CREATE REASONABLE EMISSION. THE GOAL OF THE PROPOSED PHASE I STUDY IS TO PERFORM SUFFICIENT ANALYSIS OF THE MECHANISM TO PROVIDE CREDIBLE ESTIMATES OF THE MAXIMUM CURRENT DENSITY, BEAM EMITTANCE, DUTY FACTOR, PULSE LENGTH CAPABILITY, AND SIZE AND WEIGHT. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - STRATEGIC DEFENSE APPLICATIONS THAT REQUIRE TENS OF GIGAWATTS OF PEAK BEAM POWER FOR UP TO A MICRO-SECOND OR ABOUT 10M WATTS OF CW BEAM POWER. AS A COMMERCIAL APPLICATION, THIS GUN COULD REPLACE LOW CURRENT DENSITY THERMIONIC CATHODES IN KLYSTRON DRIVEN TELEVISION TRANSMITTERS. KEY WORDS - MULTIPACTING, SECONDARY EMISSION, HIGH CURRENT DENSITY CATHODES.

POWER SPECTRA INC  
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Program Manager: RANDY CURRY  
Contract #:

Title: INNOVATIVE MEGAHERTZ OPTICALLY TRIGGERED HIGH VOLTAGE SEMICONDUCT AVALANCHE SWITCH FOR ACCELERATOR APPLICATIONS



SMALL BUSINESS INNOVATION RESEARCH PROGRAM - PHASE I  
DARPA Solicitation 90.1

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Topic #: DARPA90-023

Office:

ID #: 50382

TECHNICAL ABSTRACT - CRITICAL TO THE IMPLEMENTATION OF A COMPACT POWER CONDITIONING SYSTEM FOR ACCELERATOR SYSTEMS IS A MULTIKILOVOLT SWITCH CAPABLE OF SWITCHING KILOAMPERE CURRENTS IN A 10 MHZ BURST OF 10-20 PULSES. THE SWITCH MUST HAVE SUBNANOSECOND JITTER AND BE ABLE TO RECOVER TO FULL HOLDOFF VOLTAGE IN THE INTERPULSE PERIOD. DURING PHASE I, A PROGRAM HAS BEEN ESTABLISHED TO EVALUTE THE BULK AVALANCHE SEMICONDUCTOR SWITCH (BASS) AS A SUITABLE SWITCH CANDIDATE. AS PART OF THE PROGRAM A CONCEPTUAL POWER CONDITIONING SYSTEM DESIGN BASED ON THE BASS SWITCH WILL BE EVALUATED. AT THE CULMINATION OF THE PHASE I PROGRAM A PHASE II PROOF OF PRINCIPLE EXPERIMENTAL PLAN WILL BE PRESENTED. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - THE ANTICIPATED BENEFITS WHICH ARE ANTICIPATED FROM THIS PROGRAM ARE A MEGAHERTZ HIGH VOLTAGE SWITCH, SUITABLE FOR ACCELERATOR APPLICATIONS. DUE TO THE SPECIALIZED APPLICABILITY OF THE SWITCH, THE COMMERCIAL APPLICATION OF THE SWITCH IS LIMITED. KEY WORDS - ACCELERATOR, HIGH VOLTAGE SWITCH, HIGH CURRENT, LIGHT TRIGGERED.

CRYSTALLUME

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Program Manager: W. SMART

Contract #:

Title: NEW METHOD FOR FABRICATION OF DIAMOND-ARMORED IR OPTICAL ELEMENTS

Topic #: DARPA90-024

Office:

ID #: 50447

TECHNICAL ABSTRACT - IR OPTICS ARE OFTEN SUBJECT TO MECHANICAL EROSION WHICH CAUSES SYSTEM PERFORMANCE DEGRADATION, REQUIRES COSTLY, TIME-CONSUMING OPTIC REPAIR AND REPLACEMENT, AND LIMITS OPERATIONAL ENVELOPES FOR MANY CURRENT IR-EQUIPPED AIRCRAFT/MISSILE SYSTEMS. UNCOATED IR MATERIALS CANNOT MEET THE NEEDS OF FUTURE HYPERVELOCITY SYSTEMS. DIAMOND-COATED IR OPTICS WOULD GREATLY REDUCE OR EVEN ELIMINATE THESE PROBLEMS. DIRECT DEPOSITION OF DIAMOND ON IR MATERIALS LIKE ZNS AND ZNSE HAS BEEN TRIED AND FOUND UNSATISFACTORY. A BETTER METHOD OF FABRICATION IS PROPOSED WHICH WILL YIELD DIAMOND-COATED IR OPTICS WITH LOW DEVELOPMENT RISK. TEST SPECIMENS CAN BE MADE WITHIN 6 MONTHS AFTER PROGRAM START. TEST OF MAVERICK IR DOMES COULD BEGIN AS SOON AS 24 MONTHS AFTER PHASE II PROGRAM START. TECHNICAL AND COST-REDUCTION BENEFITS OF THIS PROPOSED WORK ARE VERY SIGNIFICANT. ANTICIPATED BENEFITS/POSSIBLE COMMERCIAL APPLICATIONS - THE PROPOSED PHASE I WORK WILL DEMONSTRATE FEASIBILITY OF A NEW METHOD OF ARMORING FRAGILE IR OPTICS. PHASE I DATA WILL GUIDE PHASE II ACTIVITIES TO PRODUCE PROTOTYPE DIAMOND-COATED IR OPTICS FOR FLIGHT TEST. SUCCESSFUL PHASE I RESULTS WILL INDICATE A PATHWAY TO FULFILL IR OPTIC PROTECTION NEEDS OF SEVERAL FUTURE HYPERVELOCITY FLIGHT SYSTEMS, AS WELL AS EXISTING GROUND-BASED IR SYSTEMS WHICH FACE EXCESSIVE WEAR OF OPTICAL ELEMENTS. COMMERCIAL SIGNIFICANCE IS VERY HIGH, AS THE METHOD CAN BE ADAPTED TO PRODUCTION OF DIAMOND-COATED PLASTICS, AN AREA OF EXTREME COMMERCIAL INTEREST. KEY WORDS - IR MATERIALS, IR OPTICS, DIAMOND-COATED IR OPTICS, MAVERICK MISSILE.

TTL TECHNIQUES

65 LIMEKILN PIKE

GLENSIDE, PA 19038

Program Manager: J. KIM

Contract #:

Title: DEVELOPMENT OF DIAMOND THIN FILM PROCESS

Topic #: DARPA90-024

Office:

ID #: 50513

TECHNICAL ABSTRACT - IN THE PAST SEVERAL YEARS THERE HAS BEEN MUCH RESEARCH AND MANY

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PUBLICATIONS REGARDING DIAMOND FILMS. HOWEVER, IT IS CLEAR THAT THERE MUST BE SIGNIFICANT IMPROVEMENT IN THIN FILM PROCESSING LEADING TO A SITUATION WHERE DIAMOND THIN FILMS CAN BE REPRODUCED RELIABLY BEFORE COST EFFECTIVE DEVICE FABRICATION CAN PROCEED. THE DEVELOPMENT OF EFFECTIVE PROCESS MONITORING AND CONTROL METHODS COMPATIBLE WITH NORMAL DEVICE FABRICATION TECHNIQUES WHICH WILL PERMIT IN-SITU MONITORING OF: PHASE PURITY, MORPHOLOGY, AND FILM STOICHIOMETRY ARE ESSENTIAL. THIS RESEARCH AND DEVELOPMENT PROPOSAL FOCUSES ON THE DEMONSTRATION AND DEVELOPMENT OF A UNIQUE IN-SITU PROCESS MONITORING INSTRUMENT CONFIGURATION THAT WILL PROVIDE CRITICAL CHARACTERIZATION DATA DURING AND AFTER FILM DEPOSITION. THE TECHNIQUES TO BE USED INCLUDE INTEGRATION AND DEVELOPMENT OF A COMBINATION OF ADVANCED IN-SITU SPECTROSCOPIC ELLIPSOMETRY (SE), ATOMIC ABSORPTION AND OPTICAL EMISSION SPECTROSCOPY (AAS AND OS), AND GLOW DISCHARGE MASS SPECTROSCOPY (GDMS). THESE TECHNIQUES HAVE BEEN PREVIOUSLY DEVELOPED BY TTL TECHNIQUES AND EFFECTIVELY UTILIZED IN OTHER DEPOSITION AREAS. IN PARTICULAR, SE, IS AN IN-SITU PROBE WHICH WILL PROVIDE CRITICAL INFORMATION DURING DEPOSITION AND POST DEPOSITION PROCESSING REGARDING THE QUALITY OF THE DIAMOND FILMS. IN THIS RESEARCH WE WILL DEMONSTRATE PROCESS CONTROL OF DIAMOND THIN FILMS USING THIS CONFIGURATION OF INSTRUMENTATION IN A LOW TEMPERATURE PLASMA DEPOSITION. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - THE RESULT OF THIS RESEARCH WILL PROVIDE A REPEATABLE AND RELIABLE LOW TEMPERATURE DIAMOND LIKE CARBON THIN FILM DEPOSITION PROCESS WHICH WILL BE TOTALLY REPRODUCIBLE AND CONTROLLABLE. THIS PROCESS WILL BE USEFUL IN THE DEPOSITION OF BOTH INFRARED SEMICONDUCTOR DEVICES AND WEAR RESISTANT COATINGS. KEY WORDS - FILM STOICHIOMETRY, IN-SITU, SPECTROSCOPIC ELLIPSOMETRY,

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Program Manager: RICHARD KAPLAN  
Contract #:  
Title: DIAMOND DEPOSITION UTILIZING ATOMIC HYDROGEN PRODUCTION  
Topic #: DARPA90-024                      Office:                      ID #: 50514

TECHNICAL ABSTRACT - THE OUTSTANDING PHYSICAL PROPERTIES OF DIAMOND IN VIRTUALLY EVERY RESPECT MAKE IT POTENTIALLY THE IDEAL MATERIAL FOR INFRARED DOMES AND OTHER ELECTROMAGNETIC WINDOWS. UNDER CERTAIN CONDITIONS, IT IS POSSIBLE TO PRODUCE DIAMOND COATINGS OR FILMS BY CHEMICAL VAPOR DEPOSITION (CVD) THROUGH THE DECOMPOSITION OF A HYDROCARBON GAS IN THE PRESENCE OF ATOMIC HYDROGEN, WHICH STABILIZES THE DIAMOND SP<sup>3</sup> BONDS AND PREFERENTIALLY REMOVES GRAPHITE AS IT IS FORMED. THE RATE OF DEPOSITION AND THE QUALITY OF THE FILM (I.E., THE PERCENTAGE OF DIAMOND) ARE BELIEVED TO BE A FUNCTION OF THE AMOUNT OF ATOMIC HYDROGEN AVAILABLE. PRESENT DEPOSITION SYSTEMS ARE BASED ON THERMAL OR MICROWAVE EXCITATION; THEY GENERATE ONLY A SMALL AMOUNT OF ATOMIC HYDROGEN, CONSEQUENTLY HAVE LOW DEPOSITION RATES, AND HAVE YET TO PRODUCE PURE DIAMOND. IN THIS PHASE I PROGRAM, ULTRAMET PROPOSES TO DESIGN, FABRICATE, AND UTILIZE A DEPOSITION SYSTEM WHICH SHOULD CONSIDERABLY INCREASE THE AMOUNT OF ATOMIC HYDROGEN AND AT THE SAME TIME ALLOW THE USE OF OXYGEN COMPOUNDS, WHICH HAVE BEEN SHOWN TO BE BENEFICIAL. BOTH DEPOSITION RATE AND FILM QUALITY SHOULD BE GREATLY ENHANCED. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - IN ADDITION TO PROVIDING WEAR/EROSION RESISTANCE FOR INFRARED AND OTHER ELECTROMAGNETIC WINDOWS, CVD DIAMOND COATINGS OR FILMS MAY FIND APPLICATION IN COMPOSITE REINFORCEMENT, WHERE DIAMOND-COATED FIBERS OR WHISKERS COULD BE PRODUCED WITH EXTREMELY HIGH STRENGTH AND RIGIDITY; SINGLE-CRYSTAL OR POLYCRYSTALLINE FILMS FOR USE IN SEMICONDUCTORS AND MICROELECTRONICS; AND DIAMOND COATINGS FOR THERMAL MANAGEMENT SUCH AS HEAT SINKS. KEY WORDS - DIAMOND, ATOMIC HYDROGEN, CHEMICAL VAPOR DEPOSITION (CVD), WEAR RESISTANCE, INFRARED DOMES, ELECTROMAGNETIC WINDOWS.

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CF TECHNOLOGIES, INC.

105 VINCENT ROAD

DEDHAM, MA 02026

Program Manager: JOHN MOSES

Contract #:

Title: SUPERCRITICAL FLUID PROCESSING OF AEROGELS

Topic #: DARPA90-025

Office:

ID #: 50443

TECHNICAL ABSTRACT - AEROGELS ARE PRODUCED USING VARIOUS SUPERCRITICAL PROCESSING AND DRYING TECHNIQUES. THESE UNUSUALLY LOW DENSITY SOLIDS HAVE REMARKABLE THERMAL AND OPTICAL PROPERTIES, ONE RESULT OF WHICH HAS BEEN THEIR DEVELOPMENT AS A TRANSPARENT INSULATOR BETWEEN DOUBLE GLAZINGS. ADDITIONALLY THEY CAN BE PRODUCED WITH LOW TEMPERATURE PROCESSING, THEY CAN HAVE VERY HIGH SURFACE AREA, THEY APPEAR TO HAVE GOOD NOISE ATTENUATION PROPERTIES, AND THEY CAN BE DESIGNED TO HAVE USEFUL ELECTRICAL PROPERTIES. IN EUROPE PARTICULARLY, NEW AEROGELS ARE BEING DEVELOPED TO EXPLOIT THESE PROPERTIES IN A WIDE RANGE OF APPLICATIONS. USING SUPERCRITICAL FLUID TECHNOLOGY, THE OBJECTIVE OF THIS WORK IS TO PRODUCE MULTICOMPONENT AEROGELS USING SUPERCRITICAL CARBON DIOXIDE LOW TEMPERATURE DRYING. SUCCESS IN DEVELOPING SUCH A PROCESS WILL OPEN UP A NUMBER OF NEW PROCESSING AND APPLICATION OPPORTUNITIES. THE DEVELOPMENT OF LOW TEMPERATURE MULTICOMPONENT AEROGELS OPENS UP THE OPPORTUNITY TO CHEMICALLY TAILOR THE AEROGEL TO THE MATERIAL NEEDS. THE FOREIGN EFFORT IN RESEARCH AND DEVELOPMENT OF AEROGELS IS MUCH GREATER THAN THAT IN THE UNITED STATES. AS A RESULT AMERICA'S PROGRESS IN RESEARCH, AND ITS DEVELOPMENT OF PROCESSING AND APPLICATIONS KNOW HOW IS LAGGING BEHIND FOREIGN COMPETITION. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - FOR MULTICOMPONENT AEROGELS INCLUDE: MANUFACTURE OF SUPERCONDUCTOR PRECURSOR, SEMICONDUCTORS, AND CAPACITORS; POROUS MATERIALS FOR STORING PROPELLANTS; NOISE ATTENUATION; CATALYSTS; AND ULTRASONIC DETECTION EQUIPMENT. SOME BENEFITS OF SUPERCRITICAL PROCESSING INCLUDE EXCELLENT REPRODUCIBILITY OF PRODUCT, LOW TEMPERATURE PROFILE FOR HEAT SENSITIVE OR REACTIVE SUBSTANCES, HIGH PURITY, AND CHEMICALLY HOMOGENEOUS MATERIAL WITH UNIFORM PHYSICAL STRUCTURE. KEY WORDS - AEROGEL, SUPERCRITICAL, CARBON DIOXIDE.

CF TECHNOLOGIES, INC.

105 VINCENT ROAD

DEDHAM, MA 02026

Program Manager: JOHN MOSES

Contract #:

Title: REACTIONS IN SUPERCRITICAL FLUID MEDIA

Topic #: DARPA90-025

Office:

ID #: 50444

TECHNICAL ABSTRACT - SUPERCRITICAL FLUIDS HAVE BEEN USED TO EXTRACT A WIDE VARIETY OF MATERIALS. THEY HAVE BEEN SHOWN TO EXHIBIT UNIQUE SOLVENT PROPERTIES SUCH AS LARGE CHANGES IN SOLUBILITY WITH MINOR CHANGES IN TEMPERATURE AND PRESSURE. THIS PROJECT SEEKS TO EXPLOIT THE COMBINATION OF THESE PROPERTIES WITH THE ADDITION OF LOW TEMPERATURE REACTION SYSTEMS TO ALLOW EXTRACTION AND DESTRUCTION OF HAZARDOUS MATERIALS INSIDE A TOTALLY ENCLOSED SYSTEM UNDER CONTROLLED CONDITIONS. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - THE BENEFITS OF THIS PROJECT IF SUCCESSFUL WILL BE THE DEVELOPMENT OF A SYSTEM CAPABLE OF CLEANING CONTAMINATED MATERIALS AND DESTROYING THE CONTAMINANTS WITHOUT RELEASE OR HANDLING OF THE CONTAMINANT. THIS TECHNOLOGY COULD HAVE POTENTIAL APPLICATIONS IN CLEANING MATERIALS RANGING FROM MACHINED PARTS TO HAZARDOUS WASTE SITES. KEY WORDS - SUPERCRITICAL, CARBON DIOXIDE, REACTION, EXTRACTION.

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Program Manager: GERALD DOYLE  
Contract #:  
Title: SUPERCRITICAL FLUID PROCESS TECHNOLOGY  
Topic #: DARPA90-025                      Office:                      ID #: 50464

TECHNICAL ABSTRACT - SUPERCRITICAL FLUID (SF) TECHNOLOGY WILL BE APPLIED TO THE DEMILITARIZATION OF EXPLOSIVES AND CHEMICAL MUNITIONS AND THE PROCESSING OF ENERGETIC MATERIALS. THE BASIC PROCESS DYNAMICS OF SF EXTRACTION (SFE) AND SF REACTION (SFR) WILL BE COMBINED WITH ON-LINE SF CHROMATOGRAPHY (SFC) AND GAS CHROMATOGRAPHY (GC). TARGET MATERIALS TO BE EXAMINED INCLUDE: (A) NITRAMINE-CONTAINING SOLID PROPELLANT FORMULATIONS, (B) LIQUID GUN AND ROCKET PROPELLANT SYSTEMS, AND (3) MICROENCAPSULATED CHEMICAL AGENT SIMULANTS. THE SF VARIABLES OF TEMPERATURE, PRESSURE, AND CO<sub>2</sub> MOBILE PHASE MODIFIER WILL BE STUDIED IN A BOX-BEHNKEN EXPERIMENTAL DESIGN. SFE AND SFR PROCESSES WILL BE SCREENED FOR MAXIMUM RECOVERY, SEPARATION, OR DETOXIFICATION OF TARGET COMPOUNDS FROM COMPLEX, MATRICES. INFORMATION FROM PHASE I WILL PROVIDE ENGINEERING DESIGN CRITERIA FOR PHASE II OPTIMIZATION AND SCALE-UP OPERATIONS. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - SUPERCRITICAL FLUID TECHNOLOGY CAN PROVIDE A SAFE, EFFECTIVE, AND ENVIRONMENTALLY SOUND TECHNOLOGY FOR THE DEMILITARIZATION OF BOTH SOLID, LIQUID GUN, ROCKET PROPELLANTS, CHEMICAL MUNITIONS, AND ENERGETIC MATERIALS PROCESSING. THE USE OF SF METHODOLOGY SHOULD RESULT IN THE DEVELOPMENT OF PROCESSES FOR THE SELECTIVE EXTRACTION OR REACTION OF ENERGETIC COMPONENTS FROM COMPLEX PROPELLANT COMPOSITIONS FOR THE DEMILITARIZATION OF CHEMICAL MUNITIONS, AND THE PROCESSING OF ENERGETIC MATERIALS. THE APPLICATIONS OF SUPERCRITICAL FLUID TECHNOLOGY IN THE COMMERCIAL SECTOR COULD BE NUMEROUS. SUPERCRITICAL FLUIDS AS REACTION MEDIA FOR THE MANUFACTURE OF PHARMACEUTICALS, POLYMERS, AND OTHER CHEMICALS COULD BE USEFUL. PROCESSES EMPLOYED IN THESE INDUSTRIES USE EXTRACTION AND SEPARATION SCHEMES WHERE SUPERCRITICAL FLUIDS COULD FIND APPLICATION. KEY WORDS - SUPERCRITICAL, FLUID, SOLVATION, EXTRACTION, REACTION, PROPELLANTS, EXPLOSIVES, ENERGETICS, AND COMPLEX MIXTURES.

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MADISON, AL 35758  
Program Manager: PORTER MITCHELL  
Contract #:  
Title: SUPERCRITICAL FLUID PROCESSING OF PROPELLANTS  
Topic #: DARPA90-025                      Office:                      ID #: 50473

TECHNICAL ABSTRACT - PROPELLANT FORMULATIONS REQUIRE THAT VERY HIGH CONCENTRATIONS OF OXIDIZER BE USED TO OBTAIN INCREASED PERFORMANCE. UNFORTUNATELY, THE GREATER THE CONTENT OF SOLIDS IN THE FORMULATION, THE MORE DIFFICULT THE PROPELLANT MIXING AND CASTING BECOMES. CONVENTIONALLY, HYDROCARBON SOLVENTS ARE ADDED TO REDUCE THE MIX VISCOSITY AND FACILITATE MIXING. THE SOLVENTS ARE REMOVED WITH HEAT AND VACUUM PRIOR TO CASTING. THE ADDITION OF HEAT ACCELERATES THE CURING OF THE PROPELLANT, THEREBY REDUCING THE POT-LIFE OF THE MIX. USING SUPERCRITICAL FLUIDS IN PLACE OF THE ORGANIC SOLVENTS IMPROVES PROCESSING. NO HEAT OR VACUUM IS REQUIRED TO REMOVE THE CRITICAL GAS AT THE TERMINATION OF MIXING, THEREFORE, ALLOWING THE POT-LIFE TO BE INCREASED. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - HIGHER PERFORMANCE PROPELLANTS ARE POSSIBLE DUE TO INCREASED SOLIDS LOADINGS. REPEATABILITY AND BATCH-TO-BATCH MIXING WILL BE IMPROVED BECAUSE MIXING CAN BE PERFORMED IN THE PRESENCE OF A LARGER AMOUNT OF DILUENT. APPLICATIONS COULD BE EXTENDED TO CAST EXPLOSIVES, CERAMICS AND COMPOSITE MANUFACTURING. KEY WORDS - SUPERCRITICAL FLUIDS, MIXING, PROPELLANT, HIGH SOLIDS, REDUCED VISCOSITY

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PHASEX CORP

360 MERRIMACK ST

LAWRENCE, MA 01843

Program Manager: VAL KRUKONIS

Contract #:

Title: SUPERCRITICAL FLUID PROCESSING OF A SINGLE-BASE PROPELLANT AND A NITRAMINE BASE MUNITION

Topic #: DARPA90-025

Office:

ID #: 50402

TECHNICAL ABSTRACT - SUPERCRITICAL FLUID PROCESSING FOR RECOVERING REUSABLE MATERIALS FROM AGED PROPELLANT AND MUNITIONS FORMULATIONS IS PROPOSED. TWO MATERIALS WILL BE EVALUATED, VIZ., A SINGLE-BASE PROPELLANT AND A NITRAMINE BASE MUNITION, AND THEY ARE MODELS FOR BROADER CLASSES OF FORMULATIONS. BASED UPON PREVIOUS WORK ON RDX AND ENERGETIC POLYMER BINDERS WHICH IS PRESENTED AS EVIDENCE FOR THE POTENTIAL OF PROCESSING THE TWO FORMULATIONS, ROUTES TO SEPARATE ADDITIVES IN SINGLE-BASE PROPELLANTS, TO SEPARATE TRACE METAL SALTS FROM NITROCELLULOSE, TO FRACTIONATE NITROCELLULOSE BY MOLECULAR WEIGHT AND NITROGEN CONTENT, AND TO EXTRACT RDX/HMX FROM CROSS LINKED ISOCYANATE BINDERS ARE DESCRIBED. AS A MEANS OF ASSESSING THE POTENTIAL FOR SUCCESSFUL COMPLETION OF A PHASE II EFFORT, THE PHASE I WORK INCLUDES A TASK DIRECTED TO THE DESIGN AND COST ESTIMATE OF A SMALL, SELF-CONTAINED AEROSOL GENERATOR. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - THE SUCCESSFUL COMPLETION OF PHASE I WILL RESULT IN THE DEMONSTRATION OF A CONCEPT ON TWO FORMULATIONS THAT CAN BE EXTENDED TO MORE GENERAL CLASSES OF FORMULATIONS. THE PHASE II PROGRAM WILL HAVE VERIFIED THE RESULTS ON THE MORE GENERAL CLASSES, AND THUS THE FEDERAL GOVERNMENT WILL HAVE THE CAPABILITIES TO RECOVER USABLE MATERIALS FROM STORED PROPELLANTS AND MUNITIONS. THE GENERAL DATA BASE FROM THIS PROGRAM WILL BE APPLICABLE TO A BROAD RANGE OF INDUSTRIAL POLYMERS. KEY WORDS - SUPERCRITICAL FLUID PROCESSING NITRAMINE EXTRACTION, SINGLE-BASE PROPELLANTS.

APPLIED SCIENCE AND TECHNOLOGY INC.

35 CABOT ROAD

WOBURN, MA 01801

Program Manager: RICHARD POST

Contract #:

Title: COMPUTATIONAL MODELING OF FLUID FLOW IN PECVD REACTORS

Topic #: DARPA90-026

Office:

ID #: 50434

TECHNICAL ABSTRACT - WE PROPOSE TO DEVELOP A FLUID MODEL FOR PECVD REACTORS. THE MODEL FOR THE ELECTRONS TAKES INTO ACCOUNT RF ENERGY ABSORPTION FOR  $V > W$ . THE ELECTRON MODEL WILL COVER LOCAL THERMODYNAMIC EQUILIBRIUM (LTE) AND KINETIC CORRECTIONS FOR THE LOWEST STATES TO ACCOUNT FOR THE DEPARTURE FROM EQUILIBRIUM SO THAT THE CODE MAY BE APPLIED TO DEPOSITION PROCESSES SUCH AS DIAMOND. THE PLASMA GENERATED RADICALS AND EXCITED SPECIES WILL BE CALCULATED FOR LTE AND KINETICALLY AS THE PRESSURE IS REDUCED. A LOCAL RADIATION PACKAGE IS PROPOSED TO TAKE INTO ACCOUNT THE GROUND STATE RESONANCE RADIATION AS ITS TRANSPORT IS A SIGNIFICANT ENERGY CHANNEL IN THE PROPOSED SYSTEM. AN EXISTING FLUID CODE WHICH ALLOWS FOR REACTING CHEMISTRY WILL BE USED TO CALCULATE THE PARTICLE FLUXES AND REACTIONS. CHEMICAL REACTIONS WILL BE ASSUMED TO BE AT THE LOCAL TEMPERATURE AND GIVEN BY AN ARRHENIUS EQUATION. THE BOUNDARY LAYER OVER WHICH THERE CAN BE RAPID CHANGES IN SPECIES IS MODELED WITH AN ADAPTIVE GRID. SEVERAL PROPOSED MODELS FOR FILM GROWTH WILL BE EVALUATED FOR THE CASE OF DIAMOND DEPOSITION. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - A COMPUTATIONAL MODEL FOR PECVD WILL INCREASE THE PREDICTIVE CAPABILITY OF PECVD PROCESSES, IN PARTICULAR THE DEPOSITION OF DIAMOND THIN FILMS, AND CAN BE USED TO SCALE-UP REACTORS FOR A WIDE VARIETY OF SHAPES, AND TO IMPROVE UNIFORMITY AND DEPOSITION RATE. THE CODE WOULD BE USED SPECIFICALLY TO MODEL THE NEEDS OF COMMERCIAL COMPANIES AND

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THE GOVERNMENT IN REACTOR DEVELOPMENT, AND IN DEVELOPING TECHNIQUES TO MEET APPLICATIONS FOR X-RAY MASK MICROELECTRONICS, AND TOOL AND OPTICAL COATINGS. KEY WORDS - PECVD, COMPUTATIONAL, FLUID DYNAMICS, DIAMOND DEPOSITION.

CERAMIC & MATERIALS PROCESSING

PO BOX 251

EAST AMHERST, NY 14051

Program Manager: HENDRIK VILJOEN

Contract #:

Title: MATHEMATICAL MODELING OF PLASMA ENHANCED CHEMICAL VAPOR DEPOSITION REACTOR

Topic #: DARPA90-026

Office:

ID #: 50374

TECHNICAL ABSTRACT - PLASMA ASSISTED CHEMICAL VAPOR DEPOSITION (PACVD) IS A TECHNIQUE OF FORMING SOLID DEPOSITS BY INITIATING CHEMICAL REACTIONS IN A GAS PHASE WITH AN ELECTRIC DISCHARGE. THE CURRENT KNOWLEDGE OF FUNDAMENTAL CHEMISTRY AND PHYSICS OF DISCHARGES AND DEPOSITION/ETCHING BEHAVIOR ARE NOT WELL UNDERSTOOD. A RESEARCH PROGRAM IS PROPOSED TO DEVELOP THE SOFTWARE FOR GRADIENTLESS PACVD REACTOR AND MULTI-DIMENSIONAL SIMULATION OF REACTIVE FLOW PROBLEMS IN THE PRESENCE OF ELECTRICAL DISCHARGE. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - COMPUTER SOFTWARE FOR CALCULATION OF GRADIENTLESS PACVD REACTOR AND SIMULATION PACKAGE FOR MULTI-DIMENSIONAL MODELING OF REACTIVE FLOWS IN THE CONTINUOUS PACVD REACTORS. KEY WORDS - PLASMA, CHEMICAL VAPOR DEPOSITION, MATHEMATICAL MODELING

CFD RESEARCH CORP

3325-D TRIANA BLVD

HUNTSVILLE, AL 35805

Program Manager: ANANTHA KIRSHNAN

Contract #:

Title: MATHEMATICAL MODELING OF FLUID FLOW IN CHEMICAL VAPOR DEPOSITION AND PLASMA REACTORS

Topic #: DARPA90-026

Office:

ID #: 50363

TECHNICAL ABSTRACT - THE PROPOSED PROJECT INVOLVES THE DEVELOPMENT OF A MATHEMATICAL MODEL THAT WILL TAKE INTO ACCOUNT ALL THE FUNDAMENTAL PHYSICAL PHENOMENA IN THE PLASMA ENHANCED CHEMICAL VAPOR DEPOSITION (PECVD) PROCESS. THE FLOW FIELD WILL BE TREATED AS FULLY COMPRESSIBLE (WITH AND WITHOUT GRAVITY) AND THE PLASMA ENHANCED REACTIONS WILL BE MODELED USING MULTI-STEP, FINITE RATE ARRHENIUS CHEMISTRY. THE BFC (BODY FITTED COORDINATES) FORMULATION WILL BE USED IN ORDER TO MODEL ARBITRARY REACTOR GEOMETRIES WITHOUT LOSS OF RESOLUTION AT THE BOUNDARIES. IN PHASE I, THE EXISTING REFLEQS CODE WILL BE MODIFIED TO INCLUDE PLASMA TRANSPORT EQUATIONS. EFFORT WILL BE FOCUSED ON UNDERSTANDING AND CORRECTLY MODELING THE PLASMA-THERMOCHEMISTRY-FLOW COUPLING. ANALYSES WILL BE DONE WITH AND WITHOUT PLASMA EFFECTS IN ORDER TO OBTAIN A PRECISE UNDERSTANDING OF THE PLASMA INFLUENCE ON THE TRANSPORT AND CHEMICAL PROCESSES. IN PHASE II, THE MATHEMATICAL MODEL WILL BE VALIDATED AGAINST EXPERIMENTAL DATA. PARALLEL EXPERIMENTAL EFFORT IS PLANNED IN ORDER TO ACQUIRE BENCHMARK VERIFICATION DATA. THE CODE WILL THEN BE EXTENDED FOR THREE-DIMENSIONAL PRACTICAL CONFIGURATIONS OF PECVD REACTORS. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - A BETTER UNDERSTANDING OF PLASMA ENHANCED CHEMICAL VAPOR DEPOSITION WILL LEAD TO IMPROVED REACTOR DESIGNS AND DEPOSITION RATES AND PRODUCTION OF MORE EFFICIENT HIGH PERFORMANCE ELECTRONIC EQUIPMENT. IT WILL ALSO EXTEND THE APPLICABILITY OF PECVD TO A WIDER RANGE OF MATERIALS. KEY WORDS - FLUID MECHANICS; CHEMICAL VAPOR DEPOSITION; PLASMA CHEMISTRY; NUMERICAL METHODS.

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ESSENTIAL RESEARCH

1737 UNION STREET, SUITE 123

SCHENECTADY, NY 12309

Program Manager: LINDA GARVERICK

Contract #:

Title: MATHEMATICAL MODELING OF PLASMA SOURCES AND PLASMA ENHANCED CHEMICAL VAPOR DEPOSITION PROCESSES

Topic #: DARPA90-026

Office:

ID #: 50459

TECHNICAL ABSTRACT - THIN FILMS FORMED BY PLASMA ENHANCED CHEMICAL VAPOR DEPOSITION (PECVD) ARE USED IN A MANY IMPORTANT PRODUCTS AND INDUSTRIES INCLUDING: INTEGRATED CIRCUITS, FLAT PANEL DISPLAYS AND RELATED THIN FILM TRANSISTOR TECHNOLOGIES, AS HARD CARBON COATINGS, AND AS MAGNETIC AND SUPERCONDUCTING MATERIALS. MODELS OF THE DEPOSITION PROCESS: HOW IT IS INFLUENCED BY REACTOR DESIGN AND OPERATING REGIME, ARE NEEDED TO STREAMLINE REACTOR DESIGN AND OPERATION. USEFUL MODELS MUST RELATE THE MACROSCOPIC FILM PROPERTIES SUCH AS GROWTH RATE, UNIFORMITY, AND COMPOSITION TO VARIATIONS IN REACTOR DESIGN AND OPERATION. INNOVATIVE MODELS ARE NECESSARY TO REGAIN THE LEAD IN PECVD EQUIPMENT MANUFACTURING AND DEPOSITION TECHNOLOGY FROM THE JAPANESE. IN PHASE I, A FRAMEWORK WILL BE ESTABLISHED TO GUIDE THE FORMULATION OF COMMERCIALY USEFUL MODELS. THE GENERAL PECVD PROCESS WILL BE VIEWED AS A CULMINATION OF 6 SUBPROCESSES: GAS FLOW, HEAT FLOW, THERMODYNAMICS, PLASMA ENERGY DISTRIBUTION, PLASMA INDUCED REACTIONS, AND SURFACE REACTIONS. A LUMPED PARAMETER ANALYSIS OF PECVD WILL BE DEVELOPED TO DETERMINE WHICH SUBPROCESSES DOMINATE ANY SPECIFIC DEPOSITION TECHNOLOGY. IN ADDITION, THE IMPORTANT PLASMA SOURCES: PARALLEL PLATE ELECTRODE, ECR SOURCES, AND TRIODE REACTOR CONFIGURATIONS, WILL BE MODELED IN ONE- AND TWO-DIMENSIONS. FINALLY, THE LUMPED PARAMETER MODEL WILL BE USED TO ANALYZE THE DEPOSITION OF AMORPHOUS SILICON AND HARD CARBON COATINGS. ANTICIPATED BENEFITS. POTENTIAL COMMERCIAL APPLICATIONS - AMONG THE BENEFITS ARE AN IMPROVED UNDERSTANDING OF PECVD AND A FORMAL STRUCTURE (THE LUMPED PARAMETER MODEL) WITH WHICH TO COMPARE REACTOR DESIGNS AND DEPOSITION TECHNOLOGIES. ANTICIPATED COMMERCIAL PRODUCTS INCLUDE MODELS TO FACILITATE THE DESIGN OF PLASMA SOURCES AND REACTORS. SOFTWARE PACKAGES WILL BE DEVELOPED TO SIMPLIFY MACHINE OPERATION AND MINIMIZE THE AMOUNT OF CHARACTERIZATION REQUIRED IN

REMSA, INC.

47 E. QUEENSWAY, SUITE 205, P.O. BOX 189

HAMPTON, VA 23669

Program Manager: JAMES TURNER

Contract #:

Title: NUMERICAL SIMULATION OF FLUID FLOW IN CVD REACTORS

Topic #: DARPA90-026

Office:

ID #: 50496

TECHNICAL ABSTRACT - IN RECENT YEARS THERE HAS BEEN A RAPIDLY GROWING INTEREST IN CVD TECHNOLOGIES AS APPLIED TO THIN FILM PROCESSING OF MATERIALS AND COATING. HOWEVER, FULLY UTILIZATION OF THE POTENTIAL OF SUCH CVD PROCESSES IN COMPOSITE MATERIALS AND DEPOSITION OF PROTECTIVE COATINGS HAVE BEEN HINDERED BY A LACK OF UNDERSTANDING AND MATHEMATICAL MODELS OF THE INTERACTIONS BETWEEN THE CHEMICAL REACTIONS, FLUID FLOW DYNAMICS AND HEAT TRANSFER WITHIN THE REACTOR. FURTHERMORE, EFFORT TO DEVELOP REALISTIC MODELS TO CVD REACTORS HAVE BEEN HAMPERED BY THE COMPLEXITY IN THE RESULTING MATHEMATICAL MODEL FOR REALISTIC SYSTEMS. SOLUTIONS TO THESE MODELS HAVE BEEN POSSIBLE VIA MAJOR SIMPLIFYING ASSUMPTIONS WHICH SUBSEQUENTLY MAKES THE FINAL RESULTS INADEQUATE OR OF LIMITED VALUE IN PROVIDING INSIGHT INTO THE SYSTEM BEHAVIOR OF REAL CVD REACTORS. THIS EFFORT WILL SPECIFICALLY BE TO DEVELOP A COMPUTATION ALGORITHM THAT CAN BE EFFECTIVELY USED TO MODEL REALISTIC CVD REACTOR CONFIGURATION WHICH WILL INCLUDE INTERACTIONS BETWEEN THE CHEMICAL REACTIONS, FLUID FLOW DYNAMICS AND HEAT TRANSFER. THE MODEL WILL THEN BE APPLIED TO AN

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IDEALIZED CVD REACTOR MODEL FOR VALIDATION IMPLEMENTATION ON A PARALLEL PROCESSOR. FINAL CODE WOULD BE MODULAR TO THAT THE RESULTING CODES COULD BE APPLIED TO OTHER AREAS OF NONLINEAR PHENOMENA. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - DEVELOPMENT OF MODULAR ALGORITHM FOR SIMULATING REALISTIC CVD REACTOR CONFIGURATIONS. THIS EFFORT WILL PROVIDE A TOOL FOR FURTHER UNDERSTANDING OF SUCH PROCESSES AND FOR DESIGNING NEW OR ALTERNATE CVD REACTOR CONFIGURATIONS. KEY WORDS - NUMERICAL ALGORITHM, NONLINEAR GALERKIN METHOD, CVD REACTORS.

SCIENTIFIC RESEARCH ASSOCIATES, INC.

50 NYE ROAD, P.O. BOX 1058

GLASTONBURY, CT 06033

Program Manager: M. MEYYAPPAN

Contract #:

Title: A COMPUTATIONAL MODEL FOR PLASMA ENHANCED CHEMICAL VAPOR DEPOSITION (PECVD)

Topic #: DARPA90-026

Office:

ID #: 50499

TECHNICAL ABSTRACT - THIS PROPOSAL ADDRESSES A PROGRAM UNDER WHICH STATE-OF-THE-ART COMPUTATIONAL FLUID DYNAMIC (CFD) PROCEDURES WOULD BE USED TO DEVELOP A MATHEMATICAL MODEL FOR PLASMA ENHANCED CHEMICAL VAPOR DEPOSITION (PECVD) PROCESS. PECVD IS AN IMPORTANT PROCESS IN THE ELECTRONICS INDUSTRY WITH AN IMPRESSIVE LIST OF APPLICATIONS. NEVERTHELESS, MATHEMATICAL MODELS TO ENHANCE THE UNDERSTANDING OF THE PROCESS ARE CURRENTLY LACKING. THIS PROGRAM PROPOSES TO DEVELOP A COMPREHENSIVE MATHEMATICAL MODEL FOR SIMULATION OF FLUID FLOW, HEAT TRANSFER AND MASS TRANSFER WITH HOMOGENEOUS AND HETEROGENEOUS CHEMICAL REACTIONS IN A PCVD REACTOR. THE INNOVATION OF THIS PROGRAM IS TO DESCRIBE THE PECVD CHEMICAL KINETICS, WHICH IS PRIMARILY DUE TO ELECTRON BOMBARDMENT OF SOURCE GASES, THROUGH A SELF-CONSISTENT SIMULATION OF ELECTRON AND ION DENSITIES AND ELECTRON TEMPERATURE. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - THE SUCCESSFUL COMPLETION OF THE RESEARCH WILL PROVIDE A COMPREHENSIVE MODEL FOR THE PLASMA ENHANCED CHEMICAL VAPOR DEPOSITION (PECVD) PROCESS, WITH A PREDICTIVE CAPABILITY ESSENTIAL FOR DESIGN PURPOSES. THE BENEFITS OF THIS PROGRAM WILL BE IMPROVED PECVD PROCESSES TO DEPOSIT VARIOUS ELECTRONIC MATERIALS OF INTEREST TO DOD. KEY WORDS - CHEMICAL VAPOR DEPOSITION, PLASMA ENHANCEMENT, MODEL, CHEMICAL REACTIONS.

ATLANTIC AEROSPACE ELECTRONICS CORP

6404 IVY LANE, SUITE 300

GREENBELT, MD 20770

Program Manager: RICHARD ORR

Contract #:

Title: DETERMINATION OF MINIMUM DIMENSION GABOR REPRESENTATIONS FOR SIGNAL DETECTION AND CHARACTERIZATION

Topic #: DARPA90-027

Office:

ID #: 50436

TECHNICAL ABSTRACT - THIS PROPOSAL ADDRESSES A TOPIC IN TIME-FREQUENCY REPRESENTATION OF SIGNALS. APPROPRIATE REPRESENTATION OF A SIGNAL CAN REDUCE ITS DESCRIPTION TO A SMALL NUMBER OF COEFFICIENTS OVER SOME BASIS SET. THIS COMPACTNESS IS BOTH ESTHETICALLY PLEASING AND, MOREOVER, INDISPENSABLE IN OBTAINING SOLUTIONS TO MANY PROBLEMS. REAL-WORLD DEFENSE PROBLEMS ARE OFTEN CONCERNED WITH DETECTION AND CHARACTERIZATION OF SIGNALS BURIED IN NOISE AND INTERFERENCE, IN WHICH CASE A COMPACT REPRESENTATION (ONE OF "LOW DIMENSIONALITY") IS KNOWN TO BE ADVANTAGEOUS. WE CONJECTURE THAT, GIVEN PARTIAL KNOWLEDGE OF A SOUGHT SIGNAL, THERE IS A "BEST" TRANSFORM (OR BASIS) THAT YIELDS A LOW-DIMENSION REPRESENTATION OF THE SIGNAL. A CENTRAL THEME OF THE PROPOSED WORK IS TO TRANSLATE, THROUGH DETERMINATION OF THE OPTIMUM BASIS, A PARTIAL DESCRIPTION OF A SIGNAL



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SET INTO A DIMENSIONALITY STATEMENT THAT HAS INTRINSIC RELATION TO THE SIGNAL SET. A SET OF ANALYTIC AND COMPUTATIONAL TASKS RELATING TO GABOR AND WAVELET REPRESENTATIONS ARE DEFINED TO ACHIEVE THIS THEORETICAL EXTENSION, WHICH WOULD VASTLY IMPROVE THE LARGELY ANECDOTAL AND NUMERICALLY EXPERIMENTAL PROCESS NOW USED FOR SELECTION OF SIGNAL REPRESENTATIONS. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - APTLY CHOSEN SIGNAL REPRESENTATIONS CAN BE SHOWN TO PROVIDE SUBSTANTIAL PROCESSING GAIN RELATIVE TO TRADITIONAL FOURIER METHODS. POTENTIAL APPLICATIONS INCLUDE SIGNAL FEATURE EXTRACTION, DETECTION OF SPREAD SPECTRUM SIGNALS AND ACOUSTIC TRANSIENTS, NONCOOPERATIVE TARGET RECOGNITION, IMAGE ANALYSIS, ETC. A SUCCESSFUL PHASE I WILL PROVIDE THE THEORETICAL BASIS FOR AN AUTOMATIC SELECTION OF TRANSFORMS FOR AN APPLICATION. PHASE II WILL STRESS APPLICATIONS, AND IN PHASE III WE ENVISION THE DESIGN AND DEVELOPMENT OF HARDWARE SYSTEMS FOR FIELD COLLECTION AND ANALYSIS OF SIGNALS. KEY WORDS - SIGNALS, GABOR REPRESENTATIONS, WAVELETS, TRANSFORMS, LOW

AWARE, INC.  
124 MOUNT AUBURN STREET  
CAMBRIDGE, MA 02138  
Program Manager: HOWARD RESNIKOFF  
Contract #:

Title: PHASE SPACE, SAMPLING, AND INTERPOLATION APPLICATIONS OF COMPACTLY SUPPORTED WAVELETS

Topic #: DARPA90-027

Office:

ID #: 50438

TECHNICAL ABSTRACT - THE RECENTLY DISCOVERED COMPACTLY SUPPORTED WAVELETS OFFER PROMISE FOR IMPROVING PERFORMANCE IN SIGNAL REPRESENTATION, NOISE SUPPRESSION, TRANSIENT ANALYSIS, COMPRESSION FOR TRANSMISSION AND STORAGE, AND SIGNAL INTERPRETATION. COMPACTLY SUPPORTED WAVELETS ARE A SPECIAL CLASS OF AFFINE WAVELETS THAT HAVE ATTRACTIVE PROPERTIES OF REPRESENTING LOCALIZED PHENOMENA SUCH AS TRANSIENTS. THEY ARE ESPECIALLY ATTRACTIVE FOR COMPUTER CALCULATION AND ADMIT EFFICIENT VLSI HARDWARE IMPLEMENTATIONS. INTERPOLATION AND RECONSTRUCTION ARE FUNDAMENTAL TO DIGITAL SIGNAL PROCESSING. COMPARISON OF A WAVELET-BASED INTERPOLATION/RECONSTRUCTION THEOREM WITH THE WHITTAKER-SHANNON SAMPLING THEOREM IS BASIC TO AN UNDERSTANDING OF THE WAYS IN WHICH WAVELET-BASED AND FOURIER-BASED METHODS DIFFER, AND TO CHARACTERIZING THE APPLICATIONS WHERE EACH PROVIDES THE BETTER PERFORMANCE. THIS WILL PROVIDE A FOUNDATION FOR COMPARISON WITH OTHER METHODS, SUCH AS THE GABOR AND THE WEYL-HEISENBERG REPRESENTATION. AWARE WILL INVESTIGATE THE APPLICATION OF COMPACTLY SUPPORTED WAVELETS TO SPECIFIC PROBLEMS THAT ARE CONCERNED WITH UNIFORM AND NON-UNIFORM SIGNAL INTERPOLATION, AND SIGNAL RECONSTRUCTION FROM SAMPLED DATA. PARTICULAR ATTENTION WILL BE GIVEN TO SPEECH SIGNAL DATA. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - BENEFITS ARE ANTICIPATED IN SPEECH COMPRESSION AND SYNTHESIS PRODUCTS; IN SPEECH SEGMENTATION SUBSYSTEMS FOR COMMERCIAL AND MILITARY APPLICATIONS; AND IN OTHER MILITARY SIGNAL PROCESSING APPLICATIONS. KEY WORDS - SIGNAL INTERPOLATION, SIGNAL RECONSTRUCTION, SPEECH COMPRESSION, WAVELETS, SAMPLING THEOREMS.

DANIEL H. WAGNER ASSOCIATES  
894 ROSS DRIVE, SUITE 205  
SUNNYVALE, CA 94089  
Program Manager: JAY EPPERSON  
Contract #:

Title: APPLICATIONS OF WAVELET THEORY IN MODELLING FUNCTIONS OF DEFENSE SYSTEMS

Topic #: DARPA90-027

Office:

ID #: 50364

TECHNICAL ABSTRACT - THE GENERAL OBJECTIVE OF THIS PROPOSAL IS TO CONDUCT BASIC RESEARCH ON DATA COMPRESSION AND PATTERN RECOGNITION PROBLEMS THAT ARE BEST TREATED THROUGH THE

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USE OF AN AFFINE WAVELET TRANSFORMATION (AWT). THROUGH BOTH NUMERICAL EXAMPLES AND ANALYTIC RESULTS WE WILL QUANTIFY THE COMPRESSION EFFECT OFFERED BY AN AWT WHEN NONSTATIONARITIES ARE PRESENT IN A SIGNAL OR IMAGE. IN THIS CONTEXT WE WILL SEEK OPTIMAL ANALYZING AND SYNTHESIZING FUNCTIONS TO BE USED BY THE AWT. WE WILL ALSO PRESENT A SERIES OF CLEAR ILLUSTRATIVE EXAMPLES DEMONSTRATING THE STRENGTH OF AN AWT IN DETECTING IMAGE FEATURES SUCH AS EDGES AND CORNERS. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - IF SUCCESSFUL IN OUR BASIC RESEARCH OBJECTIVES, WE ANTICIPATE A DIRECT IMPACT ON THE AREAS OF EFFICIENT MESSAGE AND IMAGE TRANSMISSION. OTHER AREAS OF POTENTIAL APPLICATION INCLUDE MACHINE VISION AND THE MODELING OF NONSTATIONARY SIGNALS IN RADAR AND ACOUSTICS. KEY WORDS - GABOR FUNCTIONS, WEYL-HEISENBERG WAVELETS, AFFINE WAVELETS, PHI-TRANSFORM, SIGNAL COMPRESSION, IMAGE COMPRESSION, AND MACHINE VISION.

FASTMAN INC  
1414 MILLARD ST  
BETHLEHEM, PA 18018  
Program Manager: DR MICHAEL TUCKER  
Contract #:  
Title: SIGNAL ANALYSIS USING WAVELET TIME-FREQUENCY TRANSFORMS  
Topic #: DARPA90-027                      Office:                      ID #: 50395

TECHNICAL ABSTRACT - WE WILL DEMONSTRATE SEVERAL PROPERTIES OF SIGNALS WHICH ARE BETTER DISTINGUISHED BY THE AFFINE WAVELET EXPANSION THEN BY THE SLIDING WINDOWED FOURIER TRANSFORM. WE WILL COMPARE AND CONTRAST THE WAVELET TRANSFORM TO THE WEYL-HEISENBERG TRANSFORM, EXPANSIONS BY GABOR BASIS, EXPANSIONS BY THE GENERALIZED GABOR BASIS, THE WIGNER TRANSFORM AND SEVERAL OTHER TIME-FREQUENCY TRANSFORMS. OUR THEORETICAL ANALYSIS WILL BE COMPLIMENTED BY COMPUTER SIMULATIONS. CURRENT LITERATURE ON THE WAVELET TRANSFORM IS WRITTEN IN THE LANGUAGE OF ABSTRACT MATHEMATICS. WE WILL WRITE A HANDBOOK IN THE STANDARD LANGUAGE OF SIGNAL ANALYSIS WHICH DESCRIBES THE WAVELET TRANSFORM. IT WILL INCLUDE "C" PROGRAMS WHICH CALCULATE THE WAVELET TRANSFORM FOR INPUT SIGNALS. THE HANDBOOK WILL MAKE THE WAVELET TRANSFORM ACCESSIBLE TO THE ENGINEERING COMMUNITY. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - BENEFITS INCLUDE: IMPROVED SIGNAL PROCESSING SOFTWARE, NEW FILTER ALGORITHMS, IMPROVED VISION ANALYSIS AND DATA COMPRESSION ALGORITHMS AND IMPROVED SIGNAL RECOGNITION AND DISCRIMINATION ALGORITHMS FOR RADAR AND SONAR. KEY WORDS - TIME-FREQUENCY TRANSFORMS, WAVELET TRANSFORMS, SIGNAL RECOGNITION.

PROCESS ANALYSTS, INC.  
3000 YOUNGFIELD STREET, SUITE 344  
LAKEWOOD, CO 80215  
Program Manager: BRIAN HEBLE  
Contract #:  
Title: FINITE ELEMENT SOFTWARE FOR MODELING CHEMICAL VAPOR DEPOSITION AND PLASMA REACTORS  
Topic #: DARPA90-027                      Office:                      ID #: 50491

TECHNICAL ABSTRACT - THE SUCCESS OF ADVANCED MATERIALS MANUFACTURED BY CHEMICAL VAPOR DEPOSITION PROCESS HAS LED TO APPLICATIONS OF THESE TECHNOLOGIES IN A VARIETY OF INDUSTRIES. TECHNICAL DIFFICULTIES WITH QUALITY CONTROL, SAFETY, AND PROCESS EFFICIENCY HAVE SPAWNED INDUSTRIAL R&D INTEREST TO SOLVE THESE PROBLEMS. MODELS WHICH ACCURATELY PREDICT IMPORTANT ASPECTS OF CHEMICAL VAPOR DEPOSITION AND PLASMA-ENHANCED CHEMICAL VAPOR DEPOSITION SYSTEMS WOULD SERVE AS A VALUABLE TOOL FOR UNDERSTANDING FUNDAMENTAL PHENOMENA AND HELP ADDRESS THESE MANUFACTURING ISSUES. THESE MODELS WOULD INCLUDE DESCRIPTION OF THE FLOW AND ENERGY FIELD; RF FIELDS IN A CAVITY CONTAINING A PLASMA; THE BEHAVIOR OF THE PLASMA ITSELF, INCLUDING SPATIALLY VARYING ELECTRON ENERGY DISTRIBUTIONS;

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AND THE CHEMISTRY WITHIN THE PLASMA AND ON THE SUBSTRATE SURFACE. EXISTING MODELS HAVE, AT BEST, PREDICTED TWO OF THESE PHENOMENA ON SMALL-SCALE R&D SYSTEMS. LITTLE EFFORT HAS BEEN DIRECTED TOWARD A MARKETABLE MODELING SYSTEM WHICH CAN BE APPLIED TOWARDS INDUSTRIAL PRODUCTION SYSTEMS. THIS PHASE I PROPOSAL IS PREPARED BY PROCESS ANALYSTS, INC. TO DEVELOP A PROTOTYPE FINITE-ELEMENT MODEL OF THE CHEMISTRY AND PLASMA BEHAVIOR AND INCORPORATE THIS MODEL WITH AN EXISTING COMPUTATIONAL FLUID DYNAMICS PACKAGE THAT SOLVES FLUID FLOW AND HEAT TRANSFER EQUATIONS FOR ANY TYPE OF GEOMETRY ON A WORKSTATION-BASED PLATFORM. THROUGHOUT PHASE I THE TECHNICAL FEASIBILITIES AND LIMITATIONS OF THIS APPROACH WILL BE EXPLORED THROUGH TESTING OF THE PROTOTYPE AND AN EXISTING FLUID FLOW SOLVER ON A PRODUCTION REACTOR AT GLASSTECH SOLAR, INC. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - IT IS ANTICIPATED THAT THE PHASE I PROTOTYPE WILL PROVIDE A STRONG BASIS FOR FURTHER DEVELOPMENT BY PROVIDING SOLUTIONS OF SIMPLIFIED REACTOR GEOMETRIES WITH BASIC CHEMISTRY. SUCCESSFUL COMPLETION OF THE

PROMETHEUS, INC.  
21 ARNOLD AVENUE  
NEWPORT, RI 02840  
Program Manager: JOHN BENEDETTO  
Contract #:  
Title: NON-ORTHOGONAL WAVELET EXPANSIONS AND THEIR APPLICATIONS  
Topic #: DARPA90-027                      Office:                      ID #: 50492

TECHNICAL ABSTRACT - IMPORTANT SIGNAL PROCESSING PROBLEMS, SUCH AS KEYWORD SPOTTING, CAN BE MODELED ON BIOLOGICAL AUDITORY OR VISUAL PROCESSES. THESE PROCESSES LEAD TO NON-ORTHOGONAL SIGNAL DECOMPOSITIONS IN TERMS OF GABOR OR WAVELET (AFFINE) FRAMES. THE PRIMARY OBJECTIVE OF THE PROPOSED RESEARCH IS TO DEVELOP AN EFFECTIVE COEFFICIENT-COMPUTATION THEORY FOR FRAMES, IN CONJUNCTION WITH ATTAINING MAXIMAL JOINT TEMPORAL AND SPECTRAL RESOLUTION ACCORDING TO A PRESCRIBED UNCERTAINTY PRINCIPLE CRITERION. TWO RELATED OBJECTIVES ARE TO DETERMINE DECOMPOSITION CRITERIA FOR SIGNALS IN ANGLE-OF-ARRIVAL PROBLEMS IN THE CONTEXT OF INCOMPLETE WAVELET OPERATIONS AND ROTATIONS, AND ALSO TO UNIFY THE PROPOSED TREATMENT OF FRAMES AND UNCERTAINTY PRINCIPLES WITH RECENT SIGNAL RECONSTRUCTION AND IRREGULAR SAMPLING METHODS FOR NOISY OR INCOMPLETE DATA. PHASE II IMPLEMENTATION WILL PROVIDE EFFECTIVE APPLICATIONS TO KEYWORD SPOTTING, IRREGULAR SAMPLING, DEINTERLEAVING PULSE TRAINS FOR ESM SYSTEMS, AND OTHER PROBLEMS OF INTEREST TO THE DEFENSE DEPARTMENT. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - IT IS ANTICIPATED THAT THE COEFFICIENT-COMPUTATION OF NON-ORTHOGONAL WAVELET DECOMPOSITIONS, IN TERMS OF THE SYSTEMATIC ANALYSIS OF THE FRAME OPERATOR, WILL PROVE TO BE AS EFFECTIVE AND USEFUL FOR PROCESSES REQUIRING NON-VANISHING INNER PRODUCTS AS IS THE DIGITIZATION OF WAVELET ORTHONORMAL BASES IN LINEARLY INDEPENDENT CASES. THE SPECIFIC DOD APPLICATIONS ABOVE, AS WELL AS COMMERCIAL APPLICATIONS TO SPEECH PROCESSING AND IMAGE RECOGNITION, WILL BE DEVELOPED IN PHASE II. KEY WORDS - WAVELETS, UNCERTAINTY PRINCIPLE, SAMPLING, NON-ORTHOGONAL EXPANSIONS, KEYWORD SPOTTING.

SIGNAL PROCESSING TECHNOLOGY, LTD  
703 COASTLAND DRIVE  
PALO ALTO, CA 94303  
Program Manager: B. FRIEDLANDER  
Contract #:  
Title: ARRAY PROCESSING FOR TRANSIENT SIGNALS USING WAVELET THEORY  
Topic #: DARPA90-027                      Office:                      ID #: 50502

TECHICAL ABSTRACT - CONVENTIONAL SONAR PROCESSING IS BASED ON TECHNIQUES DEVELOPED FOR

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NARROWBAND STATIONARY (LONG DURATION) SIGNALS. THE INADEQUACIES OF THESE TECHNIQUES WHEN APPLIED TO FULL SPECTRUM AND TRANSIENT SIGNALS, MOTIVATES THE SEARCH FOR NOVEL APPROACHES TO THE PROBLEM, WHICH WILL PROVIDE AN ALTERNATIVE TO "TRADITIONAL" FFT BASED PROCESSING. THE MAIN OBJECTIVES OF THE PHASE I PROJECT ARE TO DEVELOP A NEW CLASS OF ARRAY PROCESSING TECHNIQUES FOR TRANSIENT SIGNALS USING THE FRAMEWORK OF WAVELET THEORY, AND TO DEMONSTRATE THEIR ADVANTAGES OVER FFT-BASED PROCESSING. EMPHASIS WILL BE PLACED ON TRANSIENT DETECTION AND LOCALIZATION IN THE PRESENCE OF DIFFERENTIAL DOPPLER SHIFTS. THIS WORK WILL CONTINUE AND EXTEND SOME PRELIMINARY RESULTS OBTAINED BY THE PRINCIPAL INVESTIGATOR ON USING THE GABOR REPRESENTATION FOR TRANSIENT DETECTION. OUR GOAL IS TO PROVIDE A CLEAR DEMONSTRATION OF THE ADVANTAGES OF WAVELET-BASED PROCESSING FOR SOME CLASSES OF TRANSIENT SIGNALS AND PROPAGATION/SIGNAL DISTORTION MODELS. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - THE DEVELOPMENT OF WAVELET BASED TRANSIENT DETECTION AND ARRAY PROCESSING ALGORITHMS HAS CLEAR AND IMMEDIATE APPLICATIONS TO A WIDE RANGE OF UNDERWATER SURVEILLANCE SYSTEMS, AS AN IMPORTANT ADJUNCT/ENHANCEMENT OF BOTH SHORE-BASED AND PLATFORM-BASED SYSTEMS. THESE TECHNIQUES ALSO HAVE APPLICATIONS TO: DETECTION AND CLASSIFICATION OF SEISMIC SIGNALS; PROCESSING OF SHORT DURATION COMMUNICATIONS SIGNALS RECEIVED BY AN ANTENNA ARRAY; AND THE PROCESSING OF WIDEBAND RADAR SIGNALS RECEIVED BY A PHASED ARRAY. KEY WORDS - ACOUSTIC TRANSIENTS, GABOR TRANSFORM, WAVELETS, ARRAY PROCESSING, DETECTION

C. LU LABORATORY

476 ELLIS STREET

MOUNTAIN VIEW, CA 94043

Program Manager: CHIH-SHUN LU

Contract #:

Title: AN IN-SITU SENSOR UTILIZING THE PRINCIPLES OF ATOMIC ABSORPTION AND FLUORESCENCE SPECTROMETRY

Topic #: DARPA90-028

Office:

ID #: 50440

TECHNICAL ABSTRACT - AS THE SEMICONDUCTOR DEVICE FABRICATION TECHNOLOGY MOVING TOWARDS TO THE CONCEPT OF CLUSTER TOOLS AND SINGLE WAFER PROCESSING, ONE OF THE MAJOR CHALLENGES THAT FACES REAL-TIME PROCESS CONTROL IS THE DEVELOPMENT OF SUITABLE IN-SITU SENSORS TO MEASURE THE CRITICAL PROCESS PARAMETERS. AN IN-SITU SENSOR IS PROPOSED TO MEASURE ONE OF THE MOST CRITICAL PARAMETERS IN MANY SEMICONDUCTOR PROCESSES, NAMELY THE VAPOR DENSITY OF CONDENSING SPECIES NEAR THE SUBSTRATES. THE PROPOSED SENSOR COMBINES THE PRINCIPLES OF ATOMIC ABSORPTION SPECTROSCOPY AND ATOMIC FLUORESCENCE SPECTROSCOPY TO PROVIDE THE HIGH SENSITIVITY AND WIDE DYNAMIC RANGE REQUIRED IN ADVANCED SEMICONDUCTOR DEVICE FABRICATION PROCESSES. THE TECHNIQUE IS APPLICABLE TO THE CONTROL OF MATERIAL COMPOSITIONS, DEPOSITION RATES, ETCHING RATES AND PROCESS END POINT. THE SENSOR CAN OPERATE IN ULTRA HIGH VACUUM ENVIRONMENTS AS WELL AS IN PROCESS CHAMBERS OF ANY PRESSURE. IT IS NON-INTRUSIVE, COMPACT, ROBUST AND HIGHLY COST EFFECTIVE. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - THE PROPOSED IN-SITU SENSOR WOULD FIND IMMEDIATE APPLICATIONS IN MANY PROCESSES CURRENTLY EMPLOYED IN THE RESEARCH OR PRODUCTION OF SEMICONDUCTOR DEVICES. THIS IN-SITU MONITORING TECHNIQUE IS EXPECTED TO OFFER NOT ONLY BETTER REAL-TIME CONTROL TO A VARIETY OF PROCESSES BUT ALSO A NEW TOOL FOR RESEARCH IN ADVANCED DEVICE FABRICATION TECHNOLOGY. KEY WORDS - IN-SITU SENSOR, REAL-TIME SEMICONDUCTOR PROCESS CONTROL.

J.A. WOOLLAM CO.

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LINCOLN, NE 68508

Program Manager: JOHN WOOLLAM

Contract #:

Title: IN-SITU MANUFACTURING CONTROL BY ELLIPSOMETRY

SMALL BUSINESS INNOVATION RESEARCH PROGRAM - PHASE I  
DARPA Solicitation 90.1

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Topic #: DARPA90-028

Office:

ID #: 50470

TECHNICAL ABSTRACT - LIGHTWEIGHT, COST EFFECTIVE SENSORS ARE NEEDED FOR REAL TIME CONTROL DURING SEMICONDUCTOR DEVICE PROCESSING. IN ADDITION, THESE PROBES SHOULD BE POSITION SELECTIVE OVER THE SURFACE OF A WAFER DURING FILM GROWTH OR DEPOSITION. WE PROPOSE TO DEVELOP A COMPACT, SOLID STATE BASED ELLIPSOMETER FOR THIS PURPOSE. THE LIGHT BEAM WILL BE FOCUSED TO SELECTABLE SPOT SIZE AND LOCATION ON THE WAFER. THIS TECHNIQUE WILL PERMIT REAL TIME MEASUREMENT OF SUCH PARAMETERS AS DIELECTRIC FILM THICKNESS AND OPTICAL INDEX OF REFRACTION, POLYSILICON FILM THICKNESS, AND THICKNESS OF METAL FILMS (UP TO THE TRANSPARENCY LIMIT), ALL AS A FUNCTION OF TIME, AND LOCATION ON THE WAFER. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - THIS TECHNOLOGY WILL PERMIT REAL TIME CONTROL OF FILM THICKNESSES, FILM PROPERTIES (E.G., DENSITY), AND MATERIAL COMPOSITION (E.G., SI TO N RATION IN SILICON NITRIDE). PRECISE INSTRUMENTATION IS NEEDED FOR SEMICONDUCTOR DEVICE AND CIRCUIT PERFORMANCE, REPRODUCIBILITY, AND UNIFORMITY CONTROL. KEY WORDS - IN SITU PROCESS CONTROL SENSORS, ELLIPSOMETRY, SEMICONDUCTOR DEVICES.

TACAN CORPORATION  
2330 FARADAY AVENUE  
CARLSBAD, CA 92008

Program Manager: JAMES BECHTEL

Contract #:

Title: FIBER OPTIC SENSOR FOR REAL-TIME TEMPERATURE MEASUREMENT DURING SEMICONDUCTOR PROCESSING

Topic #: DARPA90-028

Office:

ID #: 50509

TECHNICAL ABSTRACT - WE PROPOSE A NEW TYPE OF FIBER OPTIC SENSOR TO PROVIDE DYNAMIC AND STEADY-STATE TEMPERATURE MEASUREMENTS OF SEMICONDUCTOR WAFERS DURING PROCESSING. PRECISE THERMAL CONTROL IN SEMICONDUCTOR PROCESSING IS CRITICAL FOR MAKING DEVICES WITH SUBMICRON GEOMETRIES AND IS OF CRUCIAL IMPORTANCE IN RAPID THERMAL PROCESSING (RTP). THE PROPOSED SENSOR CONSISTS OF A HIGH-TEMPERATURE FIBER OPTIC PROBE USING RATIO PYROMETRY TO MEASURE WAFER FRONT SURFACE TEMPERATURES. OUR WORK WILL INCLUDE STUDIES OF THE THERMAL AND OPTICAL PROPERTIES OF SEMICONDUCTOR MATERIALS, PRELIMINARY DESIGN OF THE SENSOR AND EXPERIMENTS TO SHOW THE FEASIBILITY OF THE SYSTEM. BASED ON OUR EXPERIENCE WITH FIBER OPTIC SENSORS, INCLUDING THE DEVELOPMENT OF TWO RELATED TEMPERATURE SENSORS, WE EXPECT THE OPERATING RANGE OF THIS SENSOR TO BE FROM 400 K TO GREATER THAN 1600 K WITH BETTER THAN 0.5% ACCURACY. THIS SENSOR WILL BE CHEMICALLY INERT, NONINTRUSIVE AND IMMUNE TO RF OR PLASMA INTERFERENCE. A RESPONSE TIME OF MILLISECONDS WILL ENABLE DYNAMIC TEMPERATURE MEASUREMENTS AND REAL-TIME PROCESS CONTROL. FUTURE APPLICATIONS WILL INCLUDE IMPROVED TEMPERATURE CONTROL IN SEMICONDUCTOR PROCESSING FOR ENHANCED DEVICE YIELDS, PERFORMANCE AND SPEED. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - OUR SENSOR WILL IMPROVE SEMICONDUCTOR PROCESS TEMPERATURE MONITORING AND CONTROL. THIS WILL ENABLE THE FABRICATION OF SMALLER, FASTER AND MORE COMPLEX DEVICES WITH GREATER PRODUCT YIELDS. ITS ACCURACY, REPEATABILITY AND RAPID RESPONSE TIME ARE ESPECIALLY VALUABLE IN RTP APPLICATIONS. OTHER POTENTIAL APPLICATIONS WOULD BE WHEREVER REMOTE AND INERT REAL-TIME TEMPERATURE SENSING IS REQUIRED, INCLUDING ENGINES, EXPLOSIVE ENVIRONMENTS AND HIGH POWER RF INSTRUMENTATION. THIS PROPOSED SENSOR ENABLES PYROMETRY TO BE CONDUCTED IN NON-LINE-OF-SIGHT REGIONS WITH ISOLATION OF THE SYSTEM ELECTRONICS. KEY WORDS - SEMICONDUCTOR PROCESSING TEMPERATURE MEASUREMENT, FIBER

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BALTIMORE, MD 21236

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**DARPA Solicitation 90.1**

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**Program Manager: S TRIVEDI**

**Contract #:**

**Title: THE TRAVELLING HEATER METHOD TO GROW II-VI COMPOUND SEMICONDUCTORS**

**Topic #: DARPA90-029**

**Office:**

**ID #: 50439**

**TECHNICAL ABSTRACT - BRIMROSE PROPOSES TO DEVELOP AND OPTIMIZE THE TRAVELLING HEATER METHOD (THM) FOR GROWTH OF DEVICE GRADE II-VI COMPOUND SEMICONDUCTORS ZNTE AND HG1-XZNXTE. BESIDES, IN INFRARED DETECTION, II-VI SEMICONDUCTORS, HAVE FOUND NOVEL APPLICATIONS MAKING USE OF THEIR NON-LINEAR PROPERTIES. THESE APPLICATIONS ENCOMPASS THE IMPORTANT COMPONENTS OF OPTO-ELECTRONIC TECHNOLOGY. LIKE OTHER GROWTH PROCESSES, THERE ARE MANY KNOWN AND UNKNOWN VARIABLES/GROWTH PARAMETERS INVOLVED IN THM GROWTH. HOWEVER, IT IS VERY WELL RECOGNIZED THAT DURING THE GROWTH OF SINGLE CRYSTALS MORPHOLOGY OF SOLID-LIQUID INTERFACE DETERMINES THE QUALITY OF RESULTING CRYSTALS. HENCE, IN THE PROPOSED EFFORT THE EFFECT OF TEMPERATE GRADIENT, GROWTH RATE AND SIZE AND LENGTH OF SOLVENT ZONE ON SOLID-LIQUID INTERFACE WILL BE STUDIED. RESULTS OF THIS STUDY WILL HELP OPTIMIZE THE GROWTH PARAMETERS TO OBTAIN GOOD QUALITY CRYSTALS. MOREOVER, AN ATTEMPT WILL ALSO BE MADE TO DEVELOP A TECHNIQUE FOR "IN SITU" VISUALIZATION OF S-L INTERFACE. A SIMILAR TECHNIQUE TO VISUALIZE S-L INTERFACE DURING MELT GROWTH HAS BEEN SUCCESSFULLY DEVELOPED BY BRIMROSE DURING U.S. ARMY NIGHT VISION SPONSORED CONTRACT #DAAB07-87-C-F060. SHOULD THIS WORK BECOME CLASSIFIED, BRIMROSE HAS A SECRET FACILITY CLEARANCE. ALSO, UNDER THE SBA FROM THE OFFICE OF INNOVATION RESEARCH AND TECHNOLOGY'S SIXTH YEAR RESULTS TO CONGRESS, JUNE 1989, BRIMROSE WAS SELETED FROM 9,000 COMPANIES FOR OUTSTANDING SBIR COMMERCIALIZATION PROGRESS AND SUCCESS. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - SUCCESSFUL COMPLETION OF PROPOSED PHASE I AND SUBSEQUENT PHASE II WORK WILL RESULT INTO LOW COST, LARGE SCALE PRODUCTION OF II-VI SEMICONDUCTOR CRYSTALS OF DEVICE QUALITY. THESE MATERIALS WILL HAVE APPLICATIONS FOR ACOUSTO/ELECTRO-OPTIC MODULATORS, OPTICAL ISOLATORS, HIGH GAIN OPTICAL AMPLIFIERS, FARADAY ROTATORS, AND INFRARED DETECTORS, TO**

**COLORADO RESEARCH LABORATORY**

**P.O. BOX 692**

**WALSENBURG, CO 81089**

**Program Manager: MAURICE BRAU**

**Contract #:**

**Title: TRAVELING HEATER METHOD GROWTH OF BULK COMPOUND SEMICONDUCTOR ALLOY CRYSTALS**

**Topic #: DARPA90-029**

**Office:**

**ID #: 50446**

**TECHNICAL ABSTRACT - ALL AVAILABLE (HG,CD)TE MATERIAL, BOTH DOMESTIC AND FOREIGN, IS DOMINATED BY THE PRESENCE OF IMPURITY CLUSTERS. THESE CLUSTERS ARE DETRIMENTAL TO DEVICE PERFORMANCE AND DIRECTLY IMPACT BOTH YIELD AND COST OF CURRENT FOCAL PLANE ARRAYS. RESEARCH ON A NEW METHOD OF THM GROWTH OF THESE ALLOYS IS HEREIN PROPOSED TO SOLVE THE CURRENT MATERIALS PROBLEM WHICH IS AN IMPEDIMENT TO BOTH DEVELOPMENT AND PRODUCTION OF TWO DIMENSIONAL ARRAYS. TELLURIUM, WHICH IS THE SOLVENT CURRENTLY USED IN THE GROWTH OF (HG,CD)TE BY THM, WILL BE REPLACED BY MERCURY AND AN INVERTED THERMAL PROFILE WILL BE EMPLOYED. THIS TECHNIQUE SHOULD ELIMINATE OR REDUCE THE TELLURIUM CLUSTERS AND ALSO RESULT IN IMPROVED AXIAL HOMOGENEITY. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - HIGHER FOCAL PLANE ARRAY YIELDS AT REDUCED COST IS THE IMMEDIATE BENEFIT TO DOD. WIDE BAND GAP DETECTORS FOR FIBER OPTICAL TELECOMMUNICATIONS IS A FUTURE APPLICATION. KEY WORDS - THM, COLD THM, MCT, FPA MATERIAL, CLUSTER-FREE (HG,CD)TE**

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Program Manager: BAL JINDAL

Contract #:

Title: TRAVELING HEATER METHOD GROWTH OF BULK COMPOUND SEMICONDUCTOR ALLOY CRYSTALS

Topic #: DARPA90-029

Office:

ID #: 50516

TECHNICAL ABSTRACT - SEMICONDUCTOR ALLOY CRYSTALS SUCH AS MERCURY CADMIUM TELLURIDE ARE NEEDED FOR A VARIETY OF APPLICATIONS SUCH AS THE FABRICATION OF INFRARED FOCAL PLANE ARRAYS. DEFENSE RELATED APPLICATIONS OF THESE ARRAYS INCLUDE: SURVEILLANCE, TARGET DETECTION, ACQUISITION AND TRACKING, MISSILE GUIDANCE, THERMAL IMAGING, NAVIGATIONAL AIDS AND NIGHT VISION ETC. BASED ON XACTON'S EXPERIENCE IN THE GROWTH OF II-VI COMPOUNDS, ESPECIALLY THE REMARKABLE SUCCESS ACHIEVED IN THE GROWTH OF EXCELLENT QUALITY MERCURY CADMIUM TELLURIDE, HERE WE PROPOSE A NEW AND INNOVATIVE APPROACH FOR THE DEVELOPMENT OF THE TRAVELING HEATER METHOD FOR THE GROWTH OF LARGE DIAMETER CRYSTALS OF MERCURY CADMIUM TELLURIDE AND OTHER MATERIALS. IN THIS APPROACH, THE UNIFORMITY OF THE GROWING CRYSTALS IS ACHIEVED AS A RESULT OF THERMODYNAMIC CONSTRAINTS RATHER THAN BY THE BALANCING OF DYNAMIC PARAMETERS TO AVOID INTERFACE BREAKDOWN. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - PRODUCTION OF HIGH QUALITY CRYSTALS OF COMPOUND SEMICONDUCTOR ALLOYS FOR VARIOUS MILITARY AND COMMERCIAL APPLICATIONS. THESE INCLUDE OPTICAL DEVICES SUCH AS LASERS, EMITTERS AND DETECTORS. KEY WORDS - TRAVELING HEATER METHOD, CRYSTAL GROWTH.

RFA TECHNOLOGY

20 OLD KINGS ROAD

MERRIMACK, NH 03054

Program Manager: ROBERT ADAMOWICZ

Contract #:

Title: LOW-POWER OPTICAL BEAMSTEERING WITH SELF-ASSEMBLING MICROSTRUCTURES

Topic #: DARPA90-030

Office:

ID #: 50497

TECHNICAL ABSTRACT - THIS PROJECT CONCERNS BASIC RESEARCH CHARACTERIZING SELF-ASSEMBLING MICROSTRUCTURES IN GASES AS AN ARTIFICIAL DIELECTRIC MATERIAL MEDIUM FOR LOW CONTROL POWER OPTICAL BEAMSTEERING IN SPACE-BASED LASER RADAR AND LASER COMMUNICATION SYSTEMS WHERE THE ELECTRICAL POWER IS CRITICALLY LIMITED. LOW POWER OPTICAL BEAMSTEERING WITH VOLUME HOLOGRAMS PRODUCED BY FREQUENCY AGILE TUNABLE LASERS IN THE DYNAMIC GAS/AEROSOL MEDIUM - AN ARTIFICIAL DIELECTRIC ELECTRO-OPTICAL MATERIAL (ADEM) IN WHICH THE AEROSOL COMPONENT IS BASED ON SELF-ASSEMBLING MICROSTRUCTURES (SAMS) - IS THE FOCUS OF THIS STUDY. THE GRADIENT AND MOMENTUM FORCES AND TORQUES ASSOCIATED WITH THE INTERFERENCE OF TWO COHERENT LIGHT BEAMS ON A DISTRIBUTION OF THE SAMS IN A GAS SYSTEM FORM ROTATIONAL AND TRANSLATIONAL VOLUMETRIC PHASE GRATINGS WITH DIFFRACTION EFFICIENCIES APPROACHING 100% ON TIME SCALES RANGING FROM MILLI-SECONDS TO SUB-MICROSECONDS. A STUDY OF THESE FORCES ACTING ON THE SELF-ASSEMBLING MICROSTRUCTURES, THE ENERGY AND TIME SCALES FOR GRATING FORMATION, AND INTERFERING PHENOMENA WILL ASSESS THE TECHNICAL FEASIBILITY OF THE LASER BEAMSTEERING DEVICE. THE OPTICAL RESPONSE OF THE SAM AEROSOL IS AUGMENTED AND ENHANCED BY THE INTRINSIC MORPHIC EFFECTS AND THE MICRO-STRUCTURED OR LAYERED COMPOSITION OF THE AEROSOL. A PRELIMINARY DESIGN OF A SAM-ADEM BEAMSTEERING COMPONENT WILL BE EXPLORED. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - ANTICIPATED BENEFITS OF THIS BASIC RESEARCH ARE THE DEVELOPMENT OF EFFICIENT, RAPID RESPONSE LASER BEAMSTEERING MEDIA CAPABLE OF DEFLECTING MEDIUM TO HIGH POWER LASER BEAMS AND THEIR RETURN SIGNALS USING A LOW POWER FREQUENCY AGILE CONTROL LASER. ADDITIONAL BENEFITS MAY BE IN HIGHLY EFFICIENT, DYNAMIC, OPTICAL SHIELDS AND OPTICAL FILTERS FOR PROTECTION OF SYSTEMS FROM OPTICAL PROBES. KEY WORDS - SELF-ASSEMBLING MICROSTRUCTURES, ARTIFICIAL DIELECTRICS,

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**ADVANCED TECHNOLOGY MATERIALS, INC.**

**520-B DANBURY ROAD**

**NEW MILFORD, CT 06776**

**Program Manager: PETER KIRLIN**

**Contract #:**

**Title: RAD HARD FERROELECTRIC MEMORIES**

**Topic #: DARPA90-032**

**Office:**

**ID #: 50428**

**TECHNICAL ABSTRACT - AT EVERY LEVEL OF COMPUTING THE NEED FOR FAST, NON-VOLATILE, LOW COST RANDOM ACCESS MEMORY IS APPARENT. THIN FILM FERROELECTRIC CAPACITORS ARE IDEAL FOR THIS APPLICATION BUT MATERIALS AND PROCESSES COMPATIBLE WITH STANDARD SILICON MICROELECTRONICS ARE NOT AVAILABLE. PLASMA ENHANCED CHEMICAL VAPOR DEPOSITION (PECVD) HAS RAPIDLY DEVELOPED AS A LOW COST, LOW TEMPERATURE, THIN FILM PROCESSING TECHNOLOGY, BUT HAS NOT BEEN USED TO DEPOSIT FERROELECTRIC THIN FILMS. COUPLED WITH THE IDENTIFICATION OF SUITABLE REAGENT CHEMISTRY, IT SHOULD BE POSSIBLE TO USE PECVD AS A PRACTICAL MANUFACTURING PROCESS FOR THESE MATERIALS. IN PHASE I OF THIS PROPOSAL, HIGH QUALITY FERROELECTRIC THIN FILMS OF NB DOPED PB(ZRO<sub>3</sub>, TIO<sub>3</sub>) OR PZT, WILL BE DEPOSITED ON SILICON BELOW 600OC. THIS WILL DEMONSTRATE THE FEASIBILITY OF USING PECVD TO PROVIDE FERROELECTRIC THIN FILMS WITH STATE-OF-THE-ART REMNANT POLARIZATION AND COERCIVE FIELD BUT WITH DRAMATICALLY ENHANCED RESISTANCE TO SWITCHING FATIGUE. PHASE II WILL CONCENTRATE ON THE FABRICATION OF A USEFUL FERROELECTRIC MEMORY DEVICE. ISSUES SUCH AS PATTERNING, ADDRESSING, PACKAGING, POWER-OFF MEMORY RETENTION AND RADIATION RESISTANCE WILL BE INVESTIGATED, CULMINATING IN THE DELIVERY OF A STATE-OF-THE-ART PROTOTYPE FE-CAPACITOR STORAGE CELL DEVICE. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - THE TECHNOLOGY WHICH WILL BE DEVELOPED IN THIS PROGRAM WILL PROVIDE THE DOD WITH LOW COST RADIATION HARD MEMORIES WHICH WILL NOT BE THREATENED BY INTRUSIVE ELECTROMAGNETIC FIELDS. IN ADDITION, MANY PZT COMPOSITIONS ARE OPTICALLY AND PIEZOELECTRICALLY ACTIVE AND COMMERCIAL APPLICATIONS IN OPTICAL SWITCHING AND INFRARED SENSING COULD BE EXPLOITED. KEY WORDS - FERROELECTRIC, NON-VOLATILE MEMORIES, LEAD ZIRCONATE TITANATE, RADIATION HARD.**

**AMERICAN RESEARCH CORP OF VA**

**PO BOX 3406**

**RADFORD, VA 24143**

**Program Manager: USHA VASEASHTA**

**Contract #:**

**Title: LOW TEMPERATURE ION-BEAM-ASSISTED DEPOSITION OF FERROELECTRIC THIN FILMS**

**Topic #: DARPA90-032**

**Office:**

**ID #: 50355**

**TECHNICAL ABSTRACT - RECENT APPLICATION OF CERAMICS FOR NONVOLATILE MEMORIES, THERMAL IMAGERS AND HIGH SPEED PACKAGING HAS ESTABLISHED THE NEED FOR HIGHLY ORIENTED LARGE GRAIN OR EPITAXIAL, FERROELECTRIC THIN FILMS. VARIOUS THIN FILM DEPOSITION TECHNIQUES SUCH AS VACUUM EVAPORATION, MOLECULAR BEAM EPITAXY, SPUTTERING, LASER ABLATION, SPRAY PYROLYSIS AND METAL ORGANIC CHEMICAL VAPOR DEPOSITION ARE BEING USED. HOWEVER, THESE TECHNIQUES REQUIRE HIGH PROCESSING TEMPERATURES OF 630OC DURING DEPOSITION OR POST-ANNEALING TEMPERATURES OF 800OC, IN ORDER TO PRODUCE EITHER EPITAXIAL OR HIGHLY ORIENTED FILMS. THIS PRECLUDES MOST DESIRABLE SUBSTRATES SUCH AS SILICON AND GALLIUM ARSENIDE COMPATIBLE WITH INTEGRATED CIRCUIT TECHNOLOGIES. TO RESPOND TO THIS NEED, AMERICAN RESEARCH CORPORATION OF VIRGINIA PROPOSES THE NOVEL TECHNIQUE OF ION-BEAM-ASSISTED DEPOSITION (IBAD) OF EPITAXIAL OR HIGHLY ORIENTED PZT AND PLZT FERROELECTRIC THIN FILMS AT TEMPERATURES LOWER THAN THOSE OF CONVENTIONAL DEPOSITION TECHNIQUES. THE INNOVATION IN IBAD IS THAT THE TECHNIQUE USES INDEPENDENTLY CONTROLLED LOW ENERGY (0.5 TO 1.0 KEV) ION BOMBARDMENT TO SUPPLY ADDITIONAL ENERGY TO THE ATOMS ON THE SURFACE OF THE SUBSTRATE TO REDUCE THE DEPOSITION TEMPERATURE. THE TARGET OF OPPORTUNITY IS TO DEVELOP LOW TEMPERATURE DEPOSITION PROCESSES FOR FERROELECTRIC FILMS BY SIMULTANEOUS FILM DEPOSITION AND BOMBARDMENT WITH AN**



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INDEPENDENTLY CONTROLLED ION BEAM SUCH THAT THERMALLY SENSITIVE SUBSTRATES LIKE Si AND GaAs CAN BE UTILIZED. THE OBJECTIVES OF THE PHASE I PROGRAM INCLUDE EVALUATION OF THE DEPOSITION PARAMETERS, DEVELOPMENT OF A PROCESS MODEL, FABRICATION, CHARACTERIZATION AND OPTIMIZATION OF PROOF-OF-CONCEPT SYSTEM FOR HIGHLY ORIENTED OR EPITAXIAL FERROELECTRIC THIN FILM. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - THE PROPOSED LOW TEMPERATURE ION-BEAM-ASSISTED DEPOSITION TECHNIQUE WILL IMPROVE THE QUALITY AND RELIABILITY OF ELECTRONIC DEVICES AND SEMICONDUCTOR SUBSTRATES. THE TECHNIQUE WILL ADDRESS SIGNIFICANT COMMERCIAL MARKET

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NEEDHAM HEIGHTS, MA 02194  
Program Manager: THOMAS MIX

Contract #:

Title: NOVEL INTEGRATED CIRCUIT SUBSTRATE

Topic #: DARPA90-032

Office:

ID #: 50476

TECHNICAL ABSTRACT - NEW SUBSTRATES WITH DIELECTRIC CONSTANTS OF THE ORDER OF 2 OR LESS AND HIGHER POWER DISSIPATION CAPACITIES THAN THE CURRENT STANDARD SUBSTRATE, 96% ALUMINA, ARE AMONG THE REQUIREMENTS FOR THE FASTER INTEGRATED CIRCUITS BEING DEVELOPED. MERIX PROPOSES TO DEVELOP A NEW, CERAMIC, INTEGRATED CIRCUIT SUBSTRATE MATERIAL WITH A NOVEL STRUCTURE WHICH WILL MEET THESE REQUIREMENTS. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - THE NEW SUBSTRATE WILL REMOVE SOME OF THE EXISTING BARRIERS TO THE DEVELOPMENT OF FASTER, HIGHER POWERED IC CHIPS. KEY WORDS - SUBSTRATE, INTEGRATED CIRCUIT, DIELECTRIC CONSTANT, HEAT DISSIPATION.

OPTRON SYSTEMS, INC.  
3 PLESTON COURT  
BEDFORD, MA 01730  
Program Manager: KRIKOR BEZJIAN

Contract #:

Title: THREE-DIMENSIONAL PACKAGING & INTERCONNECTION TECHNOLOGY

Topic #: DARPA90-032

Office:

ID #: 50480

TECHNICAL ABSTRACT - THE RESEARCH DESCRIBED IN THIS PROPOSAL SEEKS TO DEVELOP A NEW TYPE OF INTEGRATED CIRCUIT PACKAGING AND ELECTRICAL INTERCONNECTION TECHNOLOGY TO IMPROVE THE PERFORMANCE OF HYBRID CIRCUITS. THE TECHNIQUE MAKES USE OF A UNIQUE MULTICONDUCTOR FEEDTHROUGH SUBSTRATE INVENTED BY OPTRON SYSTEMS, INC. WHICH PROVIDES LARGE NUMBERS (23K CM-2 TO 3.2M CM-2) OF ELECTRICALLY ISOLATED, LONGITUDINAL CONDUCTORS. THIS COMPONENT EMPLOYED AS A CHIP MOUNTING SUBSTRATE, AND COMBINED WITH FLIP CHIP BONDING, AND MULTILAYER POLYIMIDE INSULATED PRINTED WIRING WILL YIELD A NEW GENERATION OF TWO- AND THREE-DIMENSIONAL HYBRID CIRCUITS. THESE CIRCUITS WILL DEMONSTRATE THE FOLLOWING ADVANTAGES OVER CURRENT HYBRIDS: AN INCREASE IN CHIP PACKING DENSITY BY AT LEAST A FACTOR OF THREE, AN INCREASE IN THE EFFECTIVENESS AND NUMBER OF HEAT DISSIPATION OPTIONS COMPATIBLE WITH HYBRID CIRCUITS, AND THE OPTION OF EASILY INTERFACED MULTILAYER PRINTED CIRCUITRY. THESE ADVANTAGES WILL LEAD TO 1) IMPROVED ELECTRICAL PERFORMANCE BY DECREASING PROPAGATION DELAYS AND ALLOWING LARGER COLLECTIONS OF HIGHER POWER, FASTER CHIPS TO BE USED ON A SINGLE HYBRID, 2) SUPERIOR INTERCONNECTION DENSITY, AND 3) INCREASED NOISE IMMUNITY. THE CURRENT PHASE I PROPOSAL SEEKS TO BEGIN DEVELOPMENT OF THIS TECHNOLOGY BY BUILDING A PROOF-OF-CONCEPT DEMONSTRATOR MODEL CIRCUIT ASSEMBLY. PHASE II WILL EXTEND THIS WORK TO A FUNCTIONING MULTI-CHIP MODULE DEVELOPMENT. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - THIS TECHNOLOGY HAS APPLICATIONS TO ALL AREAS OF ELECTRONICS WHERE SIZE AND SPEED ARE OF CONCERN. APPLICATIONS TO THE DEVELOPMENT OF HIGH PERFORMANCE,

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HIGH SPEED, SMALL SIZE ELECTRONIC PROCESSORS AND COMPUTER SYSTEMS ARE ENVISIONED. FUTURE APPLICATIONS INCLUDE MASSIVELY INTERCONNECTED NEURAL NETWORKS CONSISTING OF MULTIPLE CHIPS, AND HYBRID-SCALE PARALLEL PROCESSORS CONSISTING OF DISTRIBUTED PROCESSING CHIPS WITH MANY INTERCONNECTIONS BETWEEN NODES, SIMILAR TO THE CONNECTION MACHINE. THESE TYPES OF DEVICES HAVE THE POTENTIAL TO

**RADIANT TECHNOLOGIES**

1009 BRADBURY, SE  
ALBUQUERQUE, NM 87106

Program Manager: JOSEPH EVANS, JR.

Contract #:

Title: STUDY OF RETENTION AND FATIGUE CHARACTERISTICS OF PLZT FERROELECTRIC CERAMICS FOR APPLICATION TO NDR

Topic #: DARPA90-032

Office:

ID #: 50495

TECHNICAL ABSTRACT - RADIANT TECHNOLOGIES HAS DEVELOPED A NOVEL NON DESTRUCTIVE READ OUT FERROELECTRIC MEMORY SUITABLE FOR BOTH MILITARY AND COMMERCIAL APPLICATIONS. THE DEVICE USES THIN LEAD LANTHANUM ZIRCONATE TITANATE (PLZT) FILM AS THE MEMORY MEDIUM. SINCE PLZT HAS A WIDE RANGE OF PHASES WITH MEMORY EFFECT, THE FIRST STEP IN THE DEVELOPMENT OF NDRO BASED PRODUCTS REQUIRES THE SELECTION OF THE OPTIMUM PLZT COMPOSITION. THIS PROJECT WILL EVALUATE THE ELECTRICAL CHARACTERISTICS OF THE PLZT FERROELECTRIC CERAMIC FAMILY ACROSS ITS PHASE DIAGRAM WITH THE PURPOSE OF IDENTIFYING THAT REGION OF THE PHASE DIAGRAM WITH THE BEST ELECTRICAL CHARACTERISTICS FOR USE IN THE NDRO TECHNOLOGY. THE EFFORT WILL CONSIST OF MANUFACTURING THIN FERROELECTRIC FILM CAPACITORS FROM A MINIMUM OF 16 DIFFERENT COMPOSITIONS OF PLZT. THE CAPACITORS WILL BE EVALUATED ELECTRICALLY USING AN RT66A FERROELECTRIC TEST SYSTEM, INCLUDING FATIGUE, RETENTION, AND FUNCTIONAL STRESS RETENTION TESTS. THE RESULTS WILL BE COLLATED AND PRESENTED AS A FUNCTION OF THE PHASE DIAGRAM WITH THE MOST SUITABLE COMPOSITION FOR NDRO APPLICATIONS IDENTIFIED. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - THE FERROELECTRIC NDRO MEMORY TECHNOLOGY IS THE NEXT GENERATION IN FERROELECTRIC MEMORY EVOLUTION AND HAS THE POTENTIAL TO PENETRATE THE PRESENT SILICON BASED NONVOLATILE MEMORY AND SRAM MARKETS. THE PHASE I RESULTS WILL PROVIDE A BASIS FOR THE PHASE II EFFORT TO BUILD AND CHARACTERIZE INTEGRATED CIRCUIT SCALE FERROELECTRIC NDRO MEMORIES. ADDITIONALLY, PUBLICATION OF THE PHASE DIAGRAM WILL BENEFIT THE FERROELECTRIC COMMUNITY. KEY WORDS -

**SCHMITT TECHNOLOGY ASSOCIATES**

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Program Manager: BRET HALPERN

Contract #:

Title: FERROELECTRIC THIN FILMS FOR NONVOLATILE MEMORY APPLICATIONS

Topic #: DARPA90-032

Office:

ID #: 50498

TECHNICAL ABSTRACT - FERROELECTRIC THIN FILM MEMORIES PROVIDE AN ATTRACTIVE ALTERNATIVE TO OTHER TYPES SUCH AS PLATED WIRES AND MAGNETIC BUBBLE MEMORY; THEY ARE NON-VOLATILE, RADIATION HARD, AND CAN SWITCH STATES RAPIDLY AND AT LOW VOLTAGE. WHILE SPUTTERING AND SOL-GEL METHODS HAVE HAD SOME SUCCESS, THERE IS STILL A NEED FOR INNOVATIVE AND EFFECTIVE WAYS TO DEPOSIT FERROELECTRIC FILMS AT HIGH RATE AND WITH GOOD PROCESS CONTROL. WE SUGGEST THAT OUR REACTIVE GAS JET DEPOSITION (GJD) TECHNIQUE IS WELL SUITED TO DEPOSITION OF FERROELECTRIC OXIDES. GJD USES SUPERSONIC GAS JETS TO PROPEL ATOMS AND MOLECULES TOWARD SUBSTRATES. IT DOES NOT REQUIRE HIGH VACUUM, IS CAPABLE OF HIGH RATE DEPOSITION, AND IS SIMPLE, INEXPENSIVE, VERSATILE AND GENERAL. IN PHASE I WE WILL USE REACTIVE GJD TO DEPOSIT A

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DEMONSTRATION PZT CAPACITOR WHICH WILL BE CHARACTERIZED ELECTRICALLY, OPTICALLY AND CHEMICALLY. OUR OBJECTIVE IS TO FIND OUT IF REACTIVE GJD CAN BE THE BASIS OF A COMMERCIAL PROCESS FOR FERROELECTRIC DEPOSITION. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - NONVOLATILE ELECTRONIC MEMORIES FOR DATA STORAGE TO BE USED IN "RADIATION HARD" MILITARY AND SPACE APPLICATIONS AS WELL AS NONVOLATILE "BACKUP" MEMORY FOR THE CIVILIAN MARKET. KEY WORDS - FERROELECTRIC, NONVOLATILE MEMORY, RADIATION-HARD, THIN FILM.

TFR TECHNOLOGIES, INC.  
2601 OAKWOOD ROAD  
AMES, IA 50010  
Program Manager: KENNETH LAKIN

Contract #:

Title: ALUMINUM NITRIDE MICROWAVE ACOUSTIC FILTERS

Topic #: DARPA90-032

Office:

ID #: 50510

TECHNICAL ABSTRACT - ALUMINUM NITRIDE (AlN) IS A REFRACTORY CERAMIC WHICH EXHIBITS A HIGH PIEZOELECTRIC COEFFICIENT IN ORIENTED POLYCRYSTALLINE FORM. IT HAS BEEN USED FOR A NEW CLASS OF NOVEL HIGH FREQUENCY DEVICES, THIN FILM RESONATOR (TFR) FILTERS. THESE MICROMINIATURE FILTERS ARE NEEDED FOR MIMIC AND OTHER HIGH FREQUENCY DOD COMMUNICATION SYSTEMS. THE NEW TFR TECHNOLOGY PROMISES HIGH PERFORMANCE DEVICES THAT ARE 10,000 TIMES SMALLER THAN CONVENTIONAL TECHNOLOGIES, ARE COMPATIBLE WITH MICROWAVE CHIPS, AND ARE MADE BY THE SAME WAFER PROCESSING THAT IS EMPLOYED IN INTEGRATED CIRCUITS. TFR DEVICES FABRICATED ON GAAS AND SI SUBSTRATES HAVE SHOWN HIGH PERFORMANCE AT 1 GHZ FREQUENCIES AND SHOULD FIND APPLICATIONS IN A NUMBER OF SYSTEMS. FABRICATION OF THESE DEVICES INVOLVES UNDESIRABLE STEPS TO MECHANICALLY ISOLATE A PORTION OF THE FILM FROM THE SUBSTRATE, COMPLICATING INTEGRATION WITH MIMIC CHIPS. THIS PROJECT WILL STUDY A NOVEL APPROACH THAT TO THE ISOLATION PROBLEM WHICH WILL EFFECTIVELY ISOLATE THE RESONATOR AND ALLOW THE DEVICES TO BE FABRICATED ON A GAAS AND SI MIMIC CHIP IN A MANNER THAT DOES NOT REQUIRE ETCHING OF THE SUBSTRATE. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - SUCCESSFUL COMPLETION OF THE PHASE I AND PHASE II PROGRAMS WILL BRING TO DOD SYSTEM CONTRACTORS A SIGNIFICANT NEW TECHNOLOGY FOR IMPLEMENTATION WITH ADVANCE INTEGRATED MICROWAVE SYSTEMS. IT IS THE INTENT OF TFR TECHNOLOGIES TO BE A SUPPLIER TO MANUFACTURE THE TFR DEVICE TECHNOLOGY FOR INDUSTRY AND ENGAGE IN SECOND SOURCE LICENSING WHERE APPROPRIATE. KEY WORDS - FILTER, RESONATORS, MIMIC, PIEZOELECTRIC, ALUMINUM NITRIDE, ACOUSTIC, MICROWAVE.

AMERICAN XTAL TECHNOLOGY  
6780 SIERRA COURT, SUITE I  
DUBLIN, CA 94568

Program Manager: T. WANG

Contract #:

Title: LARGE DIAMETER CRYSTAL GROWTH OF GAAS USING THE VERTICAL-GRADIENT-FREEZE METHOD

Topic #: DARPA90-033

Office:

ID #: 50431

TECHNICAL ABSTRACT - WE PROPOSE TO USE THE VERTICAL-GRADIENT-FREEZE METHOD DEVELOPED AT AMERICAN XTAL TECHNOLOGY (AXT) FOR THE GROWTH OF LARGE DIAMETER GAAS CRYSTALS. THE VGF METHOD IS CHOSEN BECAUSE THE LOW THERMAL GRADIENT EMPLOYED IN THE GROWTH SYSTEM CAN PRODUCE GAAS WITH VERY LOW EDPS AND GOOD UNIFORMITY WHICH ARE ESSENTIAL FOR OPTOELECTRONIC APPLICATIONS. AXT HAS EXTENSIVE EXPERIENCE IN THE VGF METHOD AND HAS SUCCESSFULLY DEVELOPED THE CRYSTAL GROWTH TECHNOLOGY FOR 2" AND 3" DIAMETER GAAS CRYSTALS WITH VERY GOOD RESULTS. THE VGF CRYSTAL GROWTH PROCESS IS CONTROLLED BY A PRECISELY CONTROLLED AXISYMMETRIC FURNACE HEATER, WHICH CAN BE REPRODUCED WITH MINIMUM OPERATOR SUPERVISION AND AN EXCELLENT POTENTIAL FOR SIZE UPSCALING. IN THE PHASE I OF THE

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PROGRAM, WE WILL MODIFY THE EXISTING FURNACES AT AXT FOR THE GROWTH OF 4" DIAMETER GAAS CRYSTAL. A SMALL MELT VOLUME RUN WILL BE TARGETED AT THE END OF PHASE I PROGRAM. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - THE INDUSTRIES IN LASERS, OPTOELECTRONICS, INTEGRATED OPTOELECTRONIC DEVICES AND LARGE SCALE INTEGRATED CIRCUITS WILL ALL BENEFIT FROM THE LARGE DIAMETER GAAS WAFERS WITH LOW DISLOCATIONS AND GOOD UNIFORMITY. KEY WORDS - LARGE DIAMETER GAAS, VERTICAL-GRADIENT-FREEZE.

VIASAT, INC.  
6120 PASEO DEL NORTE, J2  
CARLSBAD, CA 92009  
Program Manager: MARK MILLER  
Contract #:  
Title: LIGHTWEIGHT PAYLOAD FOR HIGH ALTITUDE BALLOONS  
Topic #: DARPA90-034                      Office:                      ID #: 50515

TECHNICAL ABSTRACT - THIS PROPOSAL DESCRIBES A TECHNICAL CONCEPT FOR A LIGHTWEIGHT SATELLITE SURROGATE COMMUNICATIONS PAYLOAD FOR HIGH ALTITUDE BALLOONS. IT FOCUSES ON A COMPELLING, INNOVATIVE, PRACTICAL OPERATIONAL CONCEPT APPLYING A VERY LARGE BASE OF EXISTING GROUND TERMINAL EQUIPMENT. FURTHERMORE, THE CONCEPT DIRECTLY ADDRESSES A USER BASE SEVERELY LIMITED BY EXISTING TACTICAL SATELLITE TRANSMISSION ASSETS. THE PROPOSAL PRESENTS A STRAWMAN DESIGN FOR A 5 LB PAYLOAD MEETING THE REQUIREMENTS OF THE SOLICITATION ANNOUNCEMENT. THE PROPOSAL INCLUDES CANDIDATE GEOMETRIC ANALYSES, LINK ANALYSES, POWER CONSUMPTION BUDGETS AND WEIGHT BUDGETS. WE ALSO ADDRESS ADVANCED CONCEPTS THAT MIGHT BE APPLIED TO A 50LB PAYLOAD. THAT DISCUSSION INCLUDES CONSIDERATION OF THE NEW PROBLEMS ASSOCIATED WITH THE LARGER PAYLOAD, AND ALSO PRESENTS NEW POTENTIAL APPLICATIONS, INCLUDING AN EW DECEPTION MISSION. THE PROPOSAL BUILDS ON VIASAT'S EXTENSIVE FOUNDATION IN GOVERNMENT AND COMMERCIAL SATELLITE COMMUNICATIONS SYSTEMS - AS WELL AS ON OUR SUCCESSFUL PERFORMANCE ON SEVEN OTHER COMMUNICATIONS SBIR PHASE I PROGRAMS OVER THE LAST 3 YEARS. (ALL OF THOSE PROGRAMS HAVE EITHER ALREADY PROGRESSED TO PHASE II OR ARE BEING CONSIDERED FOR PHASE II AWARD). THE PROPOSAL INCLUDES SPECIFIC TECHNICAL OBJECTIVES, PROPOSED TASKS, AND A DISCUSSION OF RELATED VIASAT WORK. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - THE PRIMARY ANTICIPATED BENEFIT IS TO DEMONSTRATE A COMPELLING NEW GOVERNMENT COMMUNICATIONS RESOURCE THAT COULD BE IMMEDIATELY APPLIED TO A LARGE COMMUNITY OF EXISTING MILITARY TACTICAL SATCOM USERS THAT ARE SEVERLY LIMITED BY CURRENT TRANSMISSION ASSETS. THE EXISTING USER COULD APPLY ALREADY FIELDDED EQUIPMENT IN A NEW, COST EFFECTIVE MANNER, WITH ALMOST NO MODIFICATION TO CURRENT OPERATIONAL PROCEDURES. KEY WORDS - BALLOON, SATCOM, TACTICAL COMMUNICATION, PAYLOADS, EW, DECEPTION.

PACIFIC MONOLITHICS, INC.  
245 SANTA ANA COURT  
SUNNYVALE, CA 94086  
Program Manager: PATRICK O'SULLIVAN  
Contract #:  
Title: DEVELOPMENT OF COMPUTER AIDED DESIGN MODELS FOR MICROWAVE AND MILLIMETER WAVE DEVICES AND CIRCUITS  
Topic #: DARPA90-036                      Office:                      ID #: 50482

TECHNICAL ABSTRACT - THE PROPOSED RESEARCH IS AIMED AT IDENTIFYING AND CORRECTING THE SHORTCOMINGS OF EXISTING MICROWAVE MODELS WHEN APPLIED TO PRACTICAL MILLIMETER-WAVE DEVICES FOR USE IN MMICS. PACIFIC MONOLITHICS' HIGHLY-DEVELOPED SMALL-SIGNAL AND LARGE-SIGNAL MICROWAVE MEASUREMENT AND MODELING CAPABILITY WILL BE USED AS A STARTING POINT. PSEUDOMORPHIC MODFETS, THE MOST PRACTICAL MILLIMETER-WAVE DEVICES FOR MMIC USE

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DURING THE NEXT FIVE TO TEN YEARS, WILL BE CHARACTERIZED BY DC MEASUREMENTS, S-PARAMETER MEASUREMENTS AT FREQUENCIES UP TO 40 GHZ, AND TRANSIENT RESPONSE MEASUREMENTS. STANDARD SMALL-SIGNAL AND LARGE-SIGNAL MICROWAVE MODELS WILL BE DERIVED. THE WEAKNESSES OF THE MODELS IN THE MILLIMETER-WAVE RANGE WILL BE DETERMINED. ENHANCEMENTS TO THE MODELS WILL BE PROVIDED TO OVERCOME THE MOST SIGNIFICANT WEAKNESSES, SUCH AS THOSE DUE TO DISTRIBUTED EFFECTS, UNUSUAL TRANSCONDUCTANCE NONLINEARITY, BACKGATING AND LAG EFFECTS. THE MODEL ENHANCEMENTS WILL BE APPLIED IN THE SIMULATION OF A 35-GHZ RECEIVER CHIP, AND REMAINING SHORTCOMINGS WILL BE DETERMINED. THE ULTIMATE GOAL IS TO GENERATE A MILLIMETER-WAVE MODELING AND SIMULATION CAPABILITY, USING COMMERCIALY AVAILABLE SOFTWARE AND HARDWARE, THAT WILL BE AS EFFECTIVE AS PACIFIC MONOLITHICS' PRESENT MICROWAVE MODELING AND SIMULATION CAPABILITY. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - PACIFIC MONOLITHICS WILL BENEFIT FROM USING IMPROVED MM-WAVE MODELS IN THE REDESIGN OF A 35-GHZ RECEIVER CHIP AND IN THE DEVELOPMENT OF SUBSEQUENT COMMERCIAL AND MILITARY MM-WAVE PRODUCTS. THE GOVERNMENT WILL GAIN THE MEANS FOR OBTAINING MM-WAVE MMICS

SCIENTIFIC RESEARCH ASSOCIATES INC.

50 NYE ROAD, P.O. BOX 1058

GLASTONBURY, CT 06033

Program Manager: HAROLD GRUBIN

Contract #:

Title: CAD MODELS FOR MICROWAVE AND MILLIMETER WAVE DEVICES AND CIRCUITS

Topic #: DARPA90-036

Office:

ID #: 50500

TECHNICAL ABSTRACT - MODELS ARE NEEDED TO ACCURATELY PREDICT THE LARGE SIGNAL (NONLINEAR) PERFORMANCE OF DEVICES AND DEVICE/CIRCUIT INTERACTIONS FOR FREQUENCIES IN THE 20-100+ GHZ RANGE. THESE MODELS MUST BE PHYSICS BASED, CAPABLE OF DESCRIBING DEVICE/CIRCUIT INTERACTIONS, AND BE COMPATIBLE WITH A CAD ENVIRONMENT. TO ACHIEVE THE STATED OBJECTIVE THREE INNOVATIONS ARE USED. FIRST, THE ENTIRE PROGRAM IS BASED ON LARGE SIGNAL CONCEPTS. SECOND, THE COMPUTATIONAL MODEL IS BASED ON SOLUTION OF THE MOMENTS OF THE BOLTZMANN TRANSPORT EQUATIONS (MBTE). THE MBTE ANALYSIS WOULD ALSO INCLUDE THE EFFECTS OF PROCESSING PARAMETERS ON DEVICE PERFORMANCE. THIRD, THE MBTE ANALYSIS WOULD BE APPLIED TO DESIGN PROBLEMS THROUGH LINKAGE TO A NONLINEAR EQUIVALENT CIRCUIT ANALYSIS THAT WAS DEVELOPED BY SRA IN A STUDY SPONSORED BY THE NATIONAL SCIENCE FOUNDATION. THE NONLINEAR EQUIVALENT CIRCUIT MODEL BASED ON MBTE COMPUTED CHARACTERISTICS PERMIT VERY RAPID (LESS THAN 1 SECOND OF COMPUTER TIME) CALCULATIONS OF LARGE SIGNAL AC PERFORMANCE OF A DEVICE THAT WOULD ACCURATELY REPRODUCE MBTE CALCULATIONS. WITH THIS FAST AND ACCURATE CALCULATION PROCEDURE, DEVICE/CIRCUIT INTERACTIONS CAN BE ADDRESSED. THE NONLINEAR EQUIVALENT CIRCUIT ANALYSIS WOULD BE COMPATIBLE WITH COMMERCIALY AVAILABLE CAD SOFTWARE AND WOULD RUN ON A WORKSTATION. IN ADDITION THIS ANALYSIS COULD BE COUPLED TO A NUMERICAL OPTIMIZATION PROGRAM AND USED TO DETERMINE REALISTIC GOALS FOR DEVICE/CIRCUIT PERFORMANCE. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - BENEFITS TO THE FEDERAL GOVERNMENT AND TO THE SEMICONDUCTOR INDUSTRY INCLUDE THE CAPABILITY TO ACCURATELY MODEL LARGE SIGNAL NONLINEAR OPERATION OF ACTUAL DEVICES AND DEVICE/CIRCUIT INTERACTIONS IN THE FREQUENCY RANGE OF 20-100+ GHZ. THIS CAPABILITY WOULD COMPLEMENT SRA'S LINE OF CAD SOFTWARE, CALLED SECANT, BEING INTRODUCED IN 1990. KEY WORDS - TRANSMISSION LINE, BOLTZMANN TRANSPORT, LARGE SIGNAL,

HITTITE MICROWAVE CORP

21 CABOT RD

WOBURN, MA 01801

Program Manager: BARAK MAOZ

Contract #:

Title: CAD MODELS OF HETEROJUNCTION BIPOLAR TRANSISTORS FOR MICROWAVE APPLICATIONS

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Topic #: DARPA90-037

Office:

ID #: 50403

TECHNICAL ABSTRACT - A NUMBER OF NEW SEMICONDUCTOR DEVICES HAVE BEEN PROPOSED IN THE LAST FEW YEARS WHICH ARE STRONG CANDIDATES FOR APPLICATION IN THE 1-100 GHZ BAND. AMONGST WHICH ARE THE HIGH ELECTRON MOBILITY TRANSISTOR (HEMT), THE HETEROJUNCTION BIPOLAR TRANSISTOR (HBT), IMPROVED METAL SEMICONDUCTOR FIELD EFFECT TRANSISTORS (MESFET) AND THEIR VARIANTS. EMERGENCE OF THESE NEW DEVICES CREATED A NEED FOR ACCURATE SIMULATION TOOLS THAT CAN PREDICT AND OPTIMIZE THE PERFORMANCE OF CIRCUITS AND COMPONENTS BASED ON THESE DEVICES. AT HITITE MICROWAVE CORPORATION, WE HAVE ACQUIRED EXPERIENCE IN MODELLING SEMICONDUCTOR DEVICES OF VARIOUS TYPES INCLUDING MESFETS, DIODES AND HBTS. WE HAVE DEVELOPED SMALL AND LARGE SIGNAL MODELS FOR HBT'S AND USED THEM SUCCESSFULLY TO DESIGN MULTIFUNCTION MONOLITHIC CHIPS AT MICROWAVE FREQUENCIES. WE WILL USE THAT EXPERIENCE IN THIS WORK TO EXPLORE THE VARIOUS APPROACHES TO THE PROBLEM OF MODELLING THE HBT. IN THIS PROPOSAL WE PRESENT MODELS USED FOR OUR DESIGN, POINT OUT SOME INADEQUACIES IN EXISTING MODELS, AND PROPOSE AN APPROACH THAT IS COMPATIBLE WITH AVAILABLE SIMULATION TOOLS AND A MODELLING PROCEDURE THAT WILL IMPROVE THE ACCURACY OF SMALL AND LARGE SIGNAL MODELS FOR THE HBT. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - THIS RESEARCH WORK WILL LEAD TO A COMPREHENSIVE STUDY TO DEVISE AN ACCURATE AND USEFUL MODEL FOR THE HBT THAT CAN BE INCORPORATED INTO EXISTING AND FUTURE LARGE AND SMALL SIGNAL SIMULATION PROGRAMS. ACCURATE MODELS WILL REDUCE THE DESIGN CYCLE TIME AND IMPROVE CHANCES OF FIRST TIME SUCCESS. ALL THIS WILL LEAD TO INCREASED SCALE OF INTEGRATION AND REDUCTION OF THE MANUFACTURING COST FOR MMIC CHIPS. KEY WORDS - HETEROJUNCTION BIPOLAR TRANSISTOR, TRANSISTOR MODEL, SIMULATION PROGRAMS.

THE MELLEN COMPANY, INC.

ROUTE #5

PENACOOK, NH 03303

Program Manager: ROBERT MELLEN, SR.

Contract #:

Title: IMPLEMENTATION OF NEW GALLIUM ARSENIDE GROWTH TECH (VERTICAL FLOAT ZONE) DEVELOPED AT NAVAL RSCH LAB

Topic #: DARPA90-038

Office:

ID #: 50511

TECHNICAL ABSTRACT - THE NAVAL RESEARCH LABORATORY CURRENTLY PRODUCES HIGH PURITY, LOW DEFECT, ONE INCH DIAMETER MONOCRYSTAL GAAS BY THE LIQUID ENCAPSULATED VERTICAL ZONE MELTING TECHNIQUE (VZM) IN A SPECIALLY DESIGNED QUADRANT CONTROLLED Q-EDG FURNACE DEVELOPED BY THE MELLEN COMPANY, INC. THE UNIQUE FEATURE OF THEIR PRESENT MFLLEN FURNACE IS ITS ABILITY TO PRECISELY CONTROL THE LOCAL HEAT FLOW CHARACTERISTICS WITHIN THE MOLTEN ZONE IN THE AXIAL, AZIMUTHAL, AND RADIAL DIRECTIONS (3D). THEIR PRESENT Q-EDG VZM FURNACE IS AN OFFSHOOT OF PATENTED PRE-EXISTING MELLEN Q-EDG TECHNOLOGY USED ROUTINELY FOR BULK GROWTH OF GAAS. IT WAS DEVELOPED BY MELLEN SPECIFICALLY FOR VZM AND LATER MODIFIED BY US BASED ON OPERATING RESULTS DURING DEVELOPMENT OF THE VZM TECHNIQUE. DEFENSE SYSTEM DESIGNERS REQUIRE PRODUCTION OF 3" DIAMETER, HIGH QUALITY, SINGLE CRYSTAL GALLIUM ARSENIDE WAFER SUBSTRATES SUITABLE FOR CRITICAL APPLICATIONS. THE UTILIZATION OF MELLEN "3D" Q-EDG FURNACE TECHNOLOGY, M/A COM'S GAAS PRODUCTION EXPERIENCE, ED SIWGGARD'S ELECTRONIC MATERIALS RESEARCH EXPERIENCE (THE DEVELOPER OF VZM), ALONG WITH THE APPLICATION OF THE CONCLUSIONS FROM OUR RECENT RESEARCH PAPER "ANATOMY OF A TEMPERATURE PROFILE," SHOULD BRING TOGETHER THE PROPER TOOLS TO "MAKE IT SO." ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - THE LEVZM GROWTH TECHNIQUE USED IN CONJUNCTION WITH A MODIFIED QUADRANT CONTROLLED EDG FURNACE SYSTEM WILL BE ABLE TO CONSISTENTLY PRODUCE 3" TO 4" DIAMETER SINGLE CRYSTAL BOULES OF GAAS. THE PROCESS DEVELOPED MAY BE APPLIED TOWARD GROWING OTHER III-V AND II-VI SEMICONDUCTOR SINGLE CRYSTAL MATERIALS. KEY WORDS - GALLIUM ARSENIDE, MMIC, LEVZM.

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STEPHEN C. BUTTERFIELD

70 WARREN AVENUE

HARVARD, MA 01451

Program Manager: STEPHEN BUTTERFIELD

Contract #:

Title: A MACH COLOR SCANNER/PRINTER DRIVER STUDY

Topic #: DARPA90-039

Office:

ID #: 50505

TECHNICAL ABSTRACT - THE STUDY'S OBJECTIVE IS A MACH OPERATING SYSTEM DRIVER DESIGN AND IMPLEMENTATION PLAN FOR THE CANON COLOR SCANNER/PRINTER. DRIVER PERFORMANCE AND HARDWARE TO ACHIEVE IT WILL BE STUDIED. THE DRIVER'S INTERFACE AND PROTOCOLS, AND COMPONENTS AND TEST ENVIRONMENT WILL BE IDENTIFIED. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - ANTICIPATED BENEFIT WILL BE A 400+ DOT PER INCH COLOR SCANNING AND PRINTING CAPABILITY FOR MACH OPERATING SYSTEM MACHINES. KEY WORDS - MACH, DRIVER, PRINTER, SCANNER, COLOR.

OVONIC IMAGING SYSTEMS

1896 BARRETT ST.

TROY, MI 48084

Program Manager: VINCENT CANNELLA

Contract #:

Title: HIGH THROUGHPUT HIGH YIELD PLASMA MACHINES FOR MANUFACTURING AMLCDS

Topic #: DARPA90-040

Office:

ID #: 50481

TECHNICAL ABSTRACT - PLASMA DEPOSITION AND PLASMA REACTIVE ION ETCHING ARE CRITICAL PROCESSES IN THE PRODUCTION OF ACTIVE MATRIX LCDS. THIS IS TRUE FOR AMLCDS USING EITHER AMORPHOUS SILICON OR POLYSILICON SWITCHES. THE SUCCESSFUL COMPLETION OF THIS PROJECT WILL RESULT IN THE DESIGN AND CONSTRUCTION OF NEW-CONCEPT PLASMA DEPOSITION AND RIE PROCESSING MACHINES FOR THE MANUFACTURE OF LARGE AREA AMLCDS. THESE NEW MACHINES WILL PROVIDE A 10-FOLD INCREASE IN THROUGHPUT AND WILL REDUCE BY A FACTOR OF 5 TO 10 THE PRODUCT YIELD LOSSES DUE TO PARTICLE CONTAMINATION IN THESE PROCESSES COMPARED WITH MACHINES WHICH ARE CURRENTLY AVAILABLE TODAY. THESE THROUGHPUT IMPROVEMENTS WILL RESULT IN A ONE-THIRD REDUCTION OF THE CAPITAL EQUIPMENT COSTS NECESSARY FOR A PRODUCTION PLANT. THE INCREASED THROUGHPUT, INCREASED YIELD, AND REDUCED CAPITAL COST WILL RESULT IN A SIGNIFICANT REDUCTION IN THE MANUFACTURING COST OF AMLCDS. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - THE MAJOR ANTICIPATED BENEFIT OF THE PROPOSED WORK WILL BE A REDUCTION IN THE PRICE OF LARGE AREA, HIGH DEFINITION AMLCDS. IN THE NEAR TERM THIS WILL BENEFIT U.S. MILITARY CUSTOMERS. SINCE THIS WORK WILL "LEAP FROG" CURRENT STATE OF THE ART PLASMA MACHINES, IT WILL BE A VITAL FACTOR IN ESTABLISHING COMMERCIAL U.S. PRODUCTION OF AMLCDS COMPETITIVE WITH FOREIGN SOURCES FOR LAP-TOP COMPUTERS, WORK STATIONS, HDTV, ETC. KEY WORDS -

PHOTONICS IMAGING, INC.

6975 WALES ROAD

NORTHWOOD, OH 43619

Program Manager: PETER FRIEDMAN

Contract #:

Title: REALIZTN OF ADVANCD MANUF TECHQUES, LOW-COST FLAT-PANEL DISPLAYS VIA DEVEL OF HI-EFFIC AC-PDPS

Topic #: DARPA90-040

Office:

ID #: 50484

TECHNICAL ABSTRACT - VIRTUALLY ALL DOT-MATRIX AC-PLASMA DISPLAY PANELS (I.E., AC-PDPS) IN USE TODAY INCORPORATE A THIN-FILM COATING OF MGO. THIS DIELECTRIC IS USED FOR ITS COMBINATION

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OF HIGH ELECTRON EMISSIVITY COUPLED WITH EXCELLENT STABILITY WITH RESPECT TO ITS RESISTANCE TO SPUTTERING UNDER THE VIGOROUS CONDITIONS ASSOCIATED WITH A HIGH ENERGY GAS DISCHARGE. THE LOW ELECTRON WORK-FUNCTION AND HIGHLY REFRACTIVE NATURE OF MGO WERE RESPONSIBLE FOR THE EARLY SUCCESS OF AC-PDPS IN BECOMING THE FIRST PRACTICAL FLAT-PANEL DISPLAY TECHNOLOGY. IN ORDER TO ADVANCE THIS TECHNOLOGY IN THE 1990S WITH REGARD TO REDUCING COST AND INCREASING PERFORMANCE, IT IS PROPOSED THAT A PROGRAM TO EVALUATE NEW, HIGH EMISSIVITY, REFRACTORY ALLOYS BE INVESTIGATED. THE PROPOSED PROGRAM WOULD TAKE ADVANTAGE OF RECENT ADVANCES MADE IN DEVELOPING HIGH EMISSIVITY, MIXED CRYSTAL ALLOYS FOR USE IN HIGH-PERFORMANCE CRT CATHODES. DEVELOPMENT OF A HIGHER-EFFICIENCY AD-PDP WOULD NOT ONLY REDUCE POWER CONSUMPTION, BUT WOULD ALLOW THE USE OF ADVANCED MANUFACTURING TECHNIQUES TO ALSO REDUCE SYSTEM COST. THE IMPLICATIONS OF HIGHER EFFICIENCY ARE LOWER VOLTAGE AND LOWER POWER DRIVERS, WHICH ALLOWS: HIGHER CHIP INTEGRATION, USE OF CHIP-ON-GLASS TECHNOLOGY, REDUCED INTERCONNECT COSTS, REDUCED POWER SUPPLY COSTS, REDUCED PACKAGING COSTS, AND A FLAT-PANEL MONITOR THAT IS LIGHTER IN WEIGHT, THINNER IN PROFILE, AND MORE EFFICIENT ON BATTERIES. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - THE PROPOSED PROGRAM, IF SUCCESSFUL, WOULD HAVE A DRAMATIC IMPACT ON IMPROVING PERFORMANCE AND REDUCING COST FOR BOTH MONOCHROME AND COLOR FLAT-PANEL VIDEO AC-PDP MONITORS. THE IMPROVED AC-PDP TECHNOLOGY, IN ADDITION TO BEING LOWER COST, WOULD BE LIGHTER IN WEIGHT, THINNER IN PROFILE, AND MORE POWER EFFICIENT ON BATTERIES. IT WOULD ALSO PROPEL THE U.S. INTO A LEAD POSITION IN HDTV AND PROVIDE THE MILITARY WITH BETTER DISPLAY TECHNOLOGY.

PLANAR SYSTEMS, INC.  
1400 N.W. COMPTON DRIVE  
BEAVERTON, OR 97006  
Program Manager: RICHARD TUENGE  
Contract #:

Title: MANUFACTURING COST REDUCTION OF EL DISPLAY ETCHING & DEPOSITION TECHNOLOGY  
Topic #: DARPA90-040                      Office:                      ID #: 50487

TECHNICAL ABSTRACT - THE PROGRAM WILL DEFINE METHODS TO REDUCE THE MANUFACTURING COST OF FULL COLOR ELECTROLUMINESCENT DISPLAYS. IN PARTICULAR, THIS PROGRAM WILL INVESTIGATE A NEW INSULATOR DEPOSITION TECHNOLOGY, ELECTRON CYCLOTRON RESONANCE (ECR), THAT WILL GREATLY SIMPLIFY THE ETCHING OF THE RED, GREEN AND BLUE PRIMARY PHOSPHORS. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - DECREASE THE COST OF PROCESSING FULL COLOR TFEL DISPLAYS, WHICH IS A FLAT PANEL DISPLAY TECHNOLOGY THAT MEETS ALL MILITARY SPECIFICATIONS AND HAS OUTSTANDING PERFORMANCE FOR COMMERCIAL APPLICATIONS. KEY WORDS - DISPLAYS, EL, FULL COLOR ECR, ETCHING, INSULATOR

SPIRE CORPORATION  
PATRIOTS PARK  
BEDFORD, MA 01730  
Program Manager: STANLEY VERNON  
Contract #:

Title: MOCVD FOR LOW-COST TFEL FLAT PANEL DISPLAY MANUFACTURE  
Topic #: DARPA90-040                      Office:                      ID #: 50504

TECHNICAL ABSTRACT - THIN-FILM ELECTROLUMINESCENT (TFEL) TECHNOLOGY NOW PRODUCES MATRIX-ADDRESSED SELF-LUMINOUS FLAT PANELS WHICH COME CLOSE TO PROVIDING FULL-COLOR HIGH-DEFINITION VIDEO IMAGING. WE PROPOSE TO ADDRESS A CRITICAL MANUFACTURING ISSUE FOR TFEL PANELS: THE ECONOMICAL DEPOSITION OF BRIGHT, HIGH-EFFICIENCY EL PHOSPHORS. THE PROPOSED PROCESS SIMPLIFICATION COMPRISES THE METALORGANIC CHEMICAL VAPOR DEPOSITION (MOCVD) OF LANTHANIDE-ACTIVATED ZNS, WITH IN SITU SEEDING BY ATOMIC LAYER EPITAXY (ALE) TO ESTABLISH



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THE OPTIMAL LARGE-GRAIN COLUMNAR MICROSTRUCTURE. IN PHASE I, MOCVD PRECURSORS OF THE LANTHANIDE ACTIVATORS (SM FOR RED, TB FOR GREEN, TM FOR BLUE) WILL BE IDENTIFIED AND PROCURED; OUR PRESENT MOCVD PROCESS FOR ZNS WILL BE MODIFIED TO ACCOMMODATE THESE DOPANTS; SIMPLE MONOCHROME TFEL STRUCTURES WILL BE FABRICATED FOR DEMONSTRATING PHOSPHOR LUMINANCE; AND MOCVD/ALE SEEDING WILL BE USED TO INCREASE BRIGHTNESS. THE PHASE I GOAL IS TO DEVELOP MOCVD TO PRODUCE LANTHANIDE-ACTIVATED ZNS EL PHOSPHORS FOR EACH OF THE THREE PRIMARY COLORS. THE OVERALL PROJECT GOAL IS TO OPTIMIZE AND IMPLEMENT MOCVD AS A POTENTIALLY LOW-COST, HIGH-THROUGHPUT PROCESS FOR THE ADVANCED MANUFACTURE OF TFEL DISPLAYS, SCALABLE IN BOTH PANEL SIZE AND PRODUCTION LEVEL AN AMENABLE TO NON-PHOTOLITHOGRAPHIC PIXEL DEFINITION. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - SINCE THIS TECHNOLOGY CAN COMMUNICATE FAR MORE VISUAL INFORMATION THAN CONVENTIONAL SYSTEMS, IT WILL HAVE IMMEDIATE APPLICATIONS IN COCKPIT DISPLAYS AND DEFENSE RADAR. FURTHERMORE, BECAUSE OF THE INHERENT SCALABILITY AND ROBUSTNESS OF TFEL PANELS, THEY ARE SUITABLE FOR LARGE-SCREEN APPLICATIONS FOR WHICH CATHODE RAY TUBES ARE BOTH PROHIBITIVELY EXPENSIVE AND EXCESSIVELY FRAGILE. THEIR CHIEF COMMERCIAL APPLICATION IS HIGH-INFORMATION VIDEO IMAGING FOR MEDICAL DISPLAYS, HOME TELEVISION, AND PERSONAL COMPUTERS.

ACT, INC.  
B.F.T.C., SOUTH MOUNTAIN DRIVE  
BETHLEHEM, PA 18015  
Program Manager: IRL WARD

Contract #:

Title: DEVELOPMENT OF A DEEP ULTRAVIOLET PELLICLE FOR SUBMICRON I.C. LITHOGRAPHY

Topic #: DARPA90-041

Office:

ID #: 50426

TECHNICAL ABSTRACT - ACT, INC. IS REQUESTING A PHASE I GRANT TO PARTIALLY FUND THE COSTS OF DEVELOPING A DEEP ULTRAVIOLET (UV-2) PELLICLE MATERIAL AND PROCESS FOR PRODUCING PROTOTYPE PELLICLE FILMS FOR EVALUATION IN THE IMAGING STEP OF ADVANCED INTEGRATED CIRCUIT FABRICATION. PELLICLES ARE THIN FREE STANDING TRANSPARENT FILMS THAT PROTECT THE PHOTOMASK FROM AIRBORNE CONTAMINATION WHICH CAN RESULT IN CATASTROPHIC PRINTED DEFECTS ON THE SILICON WAFER DURING PATTERN TRANSFER FROM THE MASK. THE MATERIAL DEVELOPMENT IS BASED ON PREVIOUS WORK (4), (9) PERFORMED BY THE PRINCIPAL INVESTIGATOR IN THIS AREA AS WELL AS POLYMER STRUCTURE CONSIDERATIONS RELATING TO OPTICAL FILM TRANSMISSION IN THE UV-2 WAVELENGTH REGION. SELECTED POLYMER CANDIDATES WILL BE TESTED AND FILMS ANALYZED IN ACT'S EXISTING CLASS 100 PELLICLE CLEAN ROOM LABORATORY AT ITS BFTC LOCATION. ALSO DURING PHASE I, THE PROCESS FOR PRODUCING FREE STANDING PELLICLE FILMS SUITABLE FOR UV-2 APPLICATIONS FROM A SPIN-CASTABLE LIQUID FORMULATION WILL BE DEVELOPED AND OPTIMIZED FOR THE SELECTED MATERIAL. RUDIMENTS OF THIS PROCESS ARE KNOWN FROM PREVIOUS WORK OF THE PRINCIPAL INVESTIGATOR. FINAL SUITABILITY OF THE PREPARED PELLICLE FILM FOR DEEP U.V. MICROLITHOGRAPHY AND LASER APPLICATIONS WILL BE DETERMINED FROM ACTUAL EXPOSURE TOOL AND LASER OPTICAL BENCH TESTS AS WELL AS FILM OPTICAL TRANSMISSIONS AS OBTAINED ON A SCANNING UV-VISIBLE SPECTROMETER SUCH AS A PERKIN ELMER LAMBDA-3 OR BAUSCH & LOMB SPECTRONIC 2000. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - SUCCESSFUL DEVELOPMENT OF THE UV-2 PELLICLE FILM AND FILM FORMING PROCESS WILL RESULT IN THE CONSTRUCTION OF A MANUFACTURING FACILITY AT A COST OF \$500,000. THE FACILITY WILL BE BUILT IN CONJUNCTION WITH ACT'S PARTNER COMPANY (I.E., CONFIDENTIAL NEGOTIATION IN PROGRESS) TO PROVIDE PRODUCTION GRADE PELLICLES FOR IBM AND THE DOMESTIC NEED WHICH PRESENTLY IS APPROXIMATELY 200,000 FILMS PER YEAR (I.E., DEEP UV, UV-3 AND UV-4 FILMS).

PLASMA-QUEST INC  
315 N INTERURBAN - STE 101

SMALL BUSINESS INNOVATION RESEARCH PROGRAM - PHASE I  
DARPA Solicitation 90.1

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RICHARDSON, TX 75081

Program Manager: DR JOHN E SPENCER

Contract #:

Title: IMPROVED DRY ETCHING OF MCT USING THE PLASMA QUEST FREE RADICAL REACTOR

Topic #: DARPA90-043

Office:

ID #: 50398

TECHNICAL ABSTRACT - PLASMAQUEST, INC. PROPOSES A NUMBER OF IMPROVEMENTS TO THE PLASMAQUEST FREE RADICAL REACTOR BASED ON OUR RECENT EXPERIENCE WITH ETCHING MERCURY CADMIUM TELLURIDE (MCT) FOR THE U.S. ARMY CENTER FOR NIGHT VISION AND ELECTRO-OPTICS. REACTOR IMPROVEMENTS AND PROCESS OPTIMIZATIONS INCLUDE: MINIMIZATION OF WORKPIECE EXPOSURE TO UNDESIREABLE UV LIGHT AND THERMAL ION BOMBARDMENT, EXPLORATION OF THE USE OF ALTERNATE FREE RADICAL CHEMISTRIES, AND ETCHING AT A LOWER OPERATING TEMPERATURE. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - FREE RADICAL ETCHING IS A VACUUM-COMPATIBLE PROCESS. AS SUCH, THIS ETCHING APPROACH CAN BE INTEGRATED WITH OTHER VACUUM PROCESSES TO MANUFACTURE IR DETECTORS IN A FULLY INTEGRATED VACUUM ENVIRONMENT. THE PROPOSED PROCESS AND REACTOR IMPROVEMENTS OFFER THE POTENTIAL TO REDUCE IR DETECTOR FABRICATION COSTS AND IMPROVE YIELD. KEY WORDS - MERCURY CADMIUM TELLURIDE (MCT), IR DETECTOR FABRIATION, DRY ETCHING, FREE RADICAL ETCHING.

J.A. WOOLLAM CO.

315 SOUTH 9TH STREET, SUITE 22

LINCOLN, NE 68508

Program Manager: JOHN WOOLLAM

Contract #:

Title: NON-INVASIVE CONTROL OF II-VI SEMICONDUCTOR GROWTH

Topic #: DARPA90-044

Office:

ID #: 50471

TECHNICAL ABSTRACT - HGCDTE IS AN IMPORTANT MATERIAL FOR CONSTRUCTION OF FOCAL PLANE ARRAY INFRARED DETECTORS. YET THE MATERIAL IS DIFFICULT TO GROW WITH UNIFORM FLATNESS, HIGH HOMOGENEITY, AND WITH PRECISE CONTROL OF LAYER THICKNESSES AND ALLOY MATERIAL RATIOS. IN-SITU CONTROL OF GROWTH PARAMETERS IS PROPOSED USING SPECTROSCOPIC ELLIPSOMETRY (POLARIZED LIGHT REFLECTANCE) TAILORED IN BOTH ANGLE OF INCIDENCE AND SPECTRAL RANGE FOR OPTIMUM CONDITIONS. EQUIPMENT WILL BE BUILT AND SOFTWARE DEVELOPED TO PERMIT RAPID ACQUISITION OF POLARIZED LIGHT DATA, AND CONVERSION TO ELECTRICAL SIGNALS (DIGITAL AND ANALOG) SUITABLE FOR CONTROL OF CRYSTAL GROWTH BY VAPOR PHASE EPITAXY IN A PRODUCTION ENVIRONMENT. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - THE INSTRUMENT AND SOFTWARE WILL ALLOW THE HGCDTE CRYSTAL GROWER TO KNOW THE ALLOY RATIOS (HG/CD/TE), LAYER THICKNESSES, AND SURFACE ROUGHNESS DURING THE ACTUAL GROWTH. THIS WILL LEAD TO A HIGH DEGREE OF CONTROL AND REPRODUCIBILITY OF THE FINAL DEVICE ARRAY PERFORMANCE. KEY WORDS - HGCDTE, IN SITU PROCESS CONTROL, SPECTROSCOPIC ELLIPSOMETRY.

ALAMO INSTRUMENTS

2920 CAMINO DIABLO

WALNUT CREEK, CA 94596

Program Manager: STEPHEN PHILLIPS

Contract #:

Title: ANTI-REPRODUCTION DOCUMENT COATING

Topic #: DARPA90-045

Office:

ID #: 50381

TECHNICAL ABSTRACT - A NUMBER OF POTENTIAL ANTI-REPRODUCTION FILMS HAVE BEEN IDENTIFIED THAT WHEN APPLIED TO A DOCUMENT PROVIDES THAT DOCUMENT WITH ANTI-REPRODUCTION PROPERTIES. THESE PROPERTIES HELPS TO PREVENT THE REPRODUCTION OF THE DOCUMENT BY CONVENTION XEROGRAPHIC COPY MACHINES. THE PROGRAM WILL FOCUS ON FURTHER DEVELOPMENT

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OF THESE IDENTIFIED FILMS AND OF IDENTIFYING OTHER POTENTIAL FILMS. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - PREVENTING THE UNAUTHORIZED COPYING OF PROPRIETARY DOCUMENTS BY XEROGRAPHIC COPY MACHINES WOULD BE A VALUABLE SERVICE PROVIDED BY A LOW COST, EASY TO APPLY ANTI-REPRODUCTION FILM. KEY WORDS - FILM, XEROGRAPHIC, ANTI-REPRODUCTION, DOCUMENT, COPY

IMAGING SCIENCE TECHNOLOGIES  
P.O. BOX 8175, 3052-A BERKMAR DRIVE  
CHARLOTTESVILLE, VA 22906

Program Manager: R. SCULLY

Contract #:

Title: NON-PHOTOCOPYABLE DOCUMENT COATING

Topic #: DARPA90-045

Office:

ID #: 50467

TECHNICAL ABSTRACT - THE CONTRACTOR HAS IDENTIFIED A PHOTSENSITIVE ELEMENT WHICH IT BELIEVES CAN BE IMPLEMENTED IN A THIN-FILM COATING TO PREVENT DOCUMENT REPRODUCTION. THIS TECHNOLOGY IS BASED ON PHOTOCHROMIC MATERIALS COMPRISED OF A POLYMER MATRIX EMBODIED AS A FAST-RESPONSE FILTER WHICH PROVIDES A FAST RADIATION BLOCKING SYSTEM. THE RESEARCH WILL FOCUS ON INVESTIGATING MATERIALS THAT PROVIDE RAPID CHANGES IN ABSORPTION WITHIN THE VOLUME OF A PHOTSENSITIVE TRANSPARENT MEMBER THAT ABSORBS INCIDENT RADIATION TO PREVENT THE PHOTOCOPY OF A DOCUMENT, IS NOT AFFECTED BY AMBIENT LIGHT AND IS REVERSIBLE, SO AS NOT TO IMPEDE THE LEGIBILITY OF THE DOCUMENT. THE RESPONSE SPEED OF THE FILTER MUST BE FASTER THAN THE TIME REQUIRED TO REACH THE THRESHOLD OF DETECTABILITY IN THE PHOTSENSITIVE ELEMENT OF THE REPRODUCTION MACHINE. THE CONTRACTOR WILL SYNTHESIZE AND TEST RESPONSE TIMES OF VARIOUS COMPOUNDS IT HAS IDENTIFIED AND DEMONSTRATE THAT THE COATING DARKENS WHEN EXPOSED TO A PHOTOCOPIER SHOWING THAT THE COATED AREA WAS NOT REPRODUCED. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - APPLICATIONS FOR THIS TECHNOLOGY RELATE TO ALL CONFIDENTIAL DOCUMENTS, BOTH MILITARY AND COMMERCIAL TO PREVENT REPRODUCTION. ALSO THE PROCESS COULD BE REVERSED AND EMBODIED IN AN INK SO THAT THE INK ON CURRENCY WOULD TURN TRANSPARENT TO PREVENT COUNTERFEITING. KEY WORDS - PHOTOCHROMIC, NON-PHOTOCOPYABLE, XEROGRAPHY, RADIATION-BLOCKING.

INNOVATIVE IMAGING SYSTEMS, INC.  
19 STERLING ROAD, UNIT #2, P.O. BOX 349  
NO. BILLERICA, MA 01862

Program Manager: PETER MUELLER

Contract #:

Title: ANTI-REPRODUCTION COATINGS FOR DOCUMENTS

Topic #: DARPA90-045

Office:

ID #: 50468

TECHNICAL ABSTRACT - SURFACE TREATMENTS OF ORIGINAL DOCUMENTS (OR MODIFICATIONS TO THE PROCESS FOR PRODUCING ORIGINALS) THAT ARE DESIGNED TO PREVENT THEIR REPLICATION BY XEROGRAPHIC COPY SYSTEMS ARE CONSIDERED. IN THIS REGARD A COMPREHENSIVE STUDY IS PROPOSED WHEREIN CERTAIN VULNERABLE ASPECTS OF CONVENTIONAL COPY MACHINES AND APPROPRIATE DOCUMENT PROTECTION TECHNOLOGIES ARE IDENTIFIED. VISUAL OBSERVATION OF A PRINTED PAGE UNDER NORMAL LIGHTING CONDITIONS AND THE DETECTION-REGISTRATION CAPABILITIES OF COPY MACHINES HAVE SIGNIFICANT DIFFERENCES. A COMPARISON LEADS TO THREE CATEGORIES OF DOCUMENT MODIFICATION TO PREVENT DUPLICATION: SPECTRAL, GEOMETRIC, AND LIGHT-ACTIVATED. PHASE I INCLUDES A THOROUGH EVALUATION OF INNOVATIVE CONCEPTS UNDER ALL CATEGORIES. PROMISING IDEAS WILL BE PURSUED AND THOSE PROVED FEASIBLE WILL BE CONSIDERED FOR DEVELOPMENT IN PHASE II. ULTIMATELY THE EVALUATION OF ANTI-DUPLICATION CONCEPTS MUST CONSIDER THE DEGREE TO WHICH DOCUMENT READABILITY MAY BE DEGRADED, AS WELL AS EFFECTIVENESS IN DEFEATING THE COPY PROCESS. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL

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APPLICATIONS - IT IS ANTICIPATED THAT FRUITION OF PROPOSED ANTI-DUPLICATION INNOVATIONS WILL RESULT IN A DEMAND FOR SUCH TECHNOLOGY. IF THE TECHNOLOGY CAN BE OFFERED AS A COST-EFFECTIVE PRODUCT, IT SHOULD BE MET WITH POPULARITY FROM SECURITY-CONSCIOUS SECTORS OF GOVERNMENT AND INDUSTRY. KEY WORDS - ANTI-DUPLICATION, COPY MACHINE DEFEAT, DOCUMENT SURFACE TREATMENT.

SMARTEK  
PO BOX 8013  
SYRACUSE, NY 13217  
Program Manager: DR TENNETI V RAO  
Contract #:  
Title: PHOTO-SENSITIVE COATINGS FOR ANTI-REPRODUCTION APPLICATION  
Topic #: DARPA90-045                      Office:                      ID #: 50404

TECHNICAL ABSTRACT - A NOVEL THIN FILM COATING IS PROPOSED AS A FEASIBLE SOLUTION FOR PREVENTING THE REPRODUCTION OF VALUABLE DOCUMENTS. THE COATING WILL RETAIN ALMOST COMPLETE LEGIBILITY (WITH MINIMUM LOSS OF OPTICAL TRANSMISSION) AT NORMAL INDOOR LIGHTING PRESENT IN OFFICES. THE PRINCIPLE IS AS FOLLOWS: ANY DOCUMENT THAT NEEDS TO BE PROTECTED FROM UNINTENDED DUPLICATION WILL BE COATED WITH AN OPTICALLY SENSITIVE THIN FILM. AN OVERLAYER OF PLASTIC (POLYMER) FILM WILL BE BONDED TO THE COATED DOCUMENT THROUGH PROCESSES SIMILAR TO CONVENTIONAL LAMINATION OR PRESSURE BONDING TECHNIQUES. SUCH A PROTECTED DOCUMENT WILL STILL BE PERFECTLY READABLE UNDER MOST AMBIENT LIGHTING CONDITIONS. HOWEVER, THE COATED DOCUMENT WHEN PLACED ON A PRESENT-DAY COPIER, WILL AUTOMATICALLY TURN THE THIN FILM COATING DARK AND THUS MASKS THE UNDERLYING INFORMATION ON THE ORIGINAL. AT THE SAME TIME, THE COPIER MACHINE WILL PRODUCE A BLACK ILLEGIBLE COPY. A TENACIOUS OPERATOR MAY STILL TRY TO REMOVE THE COATING. HOWEVER, DUE TO THE STRONG BONDING BETWEEN THE PLASTIC, COATING, AND PAPER, SUCH A TAMPERING WOULD EITHER MUTILATE THE DOCUMENT OR REDUCE IT INTO PIECES. THE PHASE I PROPOSAL AIMS AT PERFORMING CERTAIN CRITICAL LABORATORY EXPERIMENTS WHICH WOULD VALIDATE THE PROPOSED APPROACH. IT WILL ALSO IDENTIFY THE SIGNIFICANT TECHNOLOGICAL PROBLEMS THAT NEED TO BE SOLVED FOR THE REALIZATION OF SUCH ANTI-REPRODUCTION COATINGS. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - ANTI-REPRODUCTION COATINGS WILL HAVE APPLICATIONS IN SEVERAL SECURITY-RELATED OFFICES SUCH AS POLICE, DEFENSE, TECHNOLOGY BASED CORPORATE LABORATORIES. THEREFORE, THE PROPOSED PHOTO-SENSITIVE COATINGS (IF FOUND SUITABLE) WOULD ATTRACT SUBSTANTIAL NEW MARKETS. COMPARED TO THE HIGH COST OF VALUABLE INFORMATION, THE COST OF ANTI-REPRODUCTION COATING WOULD BE NOMINAL, PARTICULARLY ON LARGE SCALE BASIS.

APPLIED RESEARCH ASSOCIATES, INC.  
4300 SAN MATEO BOULEVARD, NE, SUITE A220  
ALBUQUERQUE, NM 87110  
Program Manager: SCOTT BLOUIN  
Contract #:  
Title: EXPERIMENTAL EVALUATION OF THE INFLUENCE OF GEOLOGY ON EXPLOSIVE SOURCE YIELD DETERMINATION  
Topic #: DARPA90-046                      Office:                      ID #: 50432

TECHNICAL ABSTRACT - THE OVERALL TECHNICAL OBJECTIVE OF THIS RESEARCH EFFORT IS TO IDENTIFY AND QUANTIFY THE PHYSICAL PROCESSES OCCURRING CLOSE TO AN EXPLOSION IN HARD ROCK THAT GENERATES THE RADIATED SEISMIC ENERGY AND TO DETERMINE THE INFLUENCE OF FACTORS INCLUDING ROCK TYPE AND PROPERTIES, SATURATION, IN SITU STRESSES, DEPTH OF BURIAL AND SPALL, EXPLOSIVE YIELD, JOINTING CHARACTERISTICS, ETC. ON THESE PHYSICAL PROCESSES AND THE RESULTING RADIATED SEISMIC ENERGY. THE COMBINED PHASE I AND PHASE II EXPERIMENTAL EFFORTS WILL CREATE A BENCHMARK DATA SET IN HARD, BRITTLE ROCKS FOR FUTURE ANALYSIS BY DARPA RESEARCHERS. THIS

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COMPREHENSIVE DATA SET WILL ENCOMPASS GROUND MOTIONS EXTENDING FROM IMMEDIATELY ADJACENT TO AND SURROUNDING THE SOURCE, TO WELL OUT INTO THE LINEAR SEISMIC REGIME. WORK UNDER PHASE I WILL DEMONSTRATE THE SOUNDNESS OF THE EXPERIMENTAL TECHNIQUES TO INSURE HIGH CONFIDENCE IN SUCCESSFUL COMPLETION OF THE MORE COMPREHENSIVE PHASE II EFFORT AND WILL ALSO GENERATE A LIMITED INITIAL DATA SET IN A HARD UNIFORM ROCK. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - THIS RESEARCH WILL PERMIT MORE ACCURATE DETERMINATION OF NUCLEAR WEAPON TEST YIELDS AND ENHANCE DISCRIMINATION CAPABILITIES. KEY WORDS - ROCK DYNAMICS, UNDERGROUND NUCLEAR TESTING, SEISMIC COUPLING, EXPLOSION MECHANICS, GROUND MOTION, VERIFICATION/MONITORING.

NEW ENGLAND RESEARCH INC

76 OLCOTT DR

WHITE RIVER JCT, VT 05501

Program Manager: RANDOLPH MARTIN III

Contract #:

Title: EXPERIMENTAL DETERMINATION OF DIFFERENCES IN SEISMIC COUPLING OF EXPLOSIONS DETONATED IN DIFFERENT HARD BRITTLE ROCKS

Topic #: DARPA90-046

Office:

ID #: 50388

TECHNICAL ABSTRACT - A COMPREHENSIVE EXPERIMENTAL PROGRAM IS PROPOSED TO STUDY THE SEISMIC COUPLING OF EXPLOSIONS DETONATED IN BRITTLE ROCKS. THE ULTIMATE OBJECTIVE IS A USER-FRIENDLY DATABASE WHICH ENABLES RESEARCHERS IN THE FIELD TO OBTAIN APPROPRIATE PHYSICAL ROCK PROPERTIES FOR NUMERICAL MODELLING. TO ACCOMPLISH THIS GOAL, IT IS NECESSARY TO SCALE EASILY OBTAINABLE LABORATORY DATA TO THE FIELD. THIS REQUIRES THE DEVELOPMENT OF A REALISTIC SCALING LAW THAT TAKES INTO ACCOUNT THE EFFECT OF FRACTURES, LARGE SCALE HETEROGENEITIES, WATER SATURATION, AND LOADING HISTORY ON THE BEHAVIOR OF ROCKS. THE SCALING LAW WILL BE DEVELOPED BY CONDUCTING BOTH LABORATORY AND FIELD SCALE EXPERIMENTS UNDER STATIC AND EXPLOSIVE LOADING CONDITIONS. THE FIELD EXPERIMENT WILL CONSIDER YIELD SCALING, THE SCALING OF FRACTURES AND THEIR INFLUENCE ON THE DETERMINATION OF YIELD, AND THE EFFECT OF FLUID SATURATION ON SEISMIC COUPLING. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - A USER FRIENDLY DATABASE AVAILABLE TO RESEARCHERS INTERESTED IN THE VERIFICATION AND YIELD ESTIMATION OF UNDERGROUND NUCLEAR EXPLOSIONS. KEY WORDS - SEISMIC COUPLING, SCALING LAW, PHYSICAL ROCK PROPERTIES, ANISOTROPY.

QUEST INTEGRATED, INC.

21414 68TH AVENUE SOUTH

KENT, WA 98032

Program Manager: JACK KOLLE

Contract #:

Title: EXPLOSIVE PULSE GENERATOR FOR IN-SITU SEISMIC COUPLING STUDIES

Topic #: DARPA90-046

Office:

ID #: 50494

TECHNICAL ABSTRACT - A HYDRAULICALLY DRIVEN EXPLOSIVE PULSE GENERATOR DEVELOPED FOR NONEXPLOSIVE HARDROCK EXCAVATION WILL BE EVALUATED AS A CONVENIENT SOURCE OF ENERGY FOR STUDIES OF SEISMIC COUPLING PROPERTIES OF FORMATIONS USED IN NUCLEAR TESTING. TESTS HAVE SHOWN THAT SUCH A DEVICE IS CAPABLE OF GENERATING 500-KJ PRESSURE PULSES WITH PEAK PRESSURES OF 450 MPA AND RISE TIMES OF 300 MICROSECONDS. THE PROPOSED STUDY WILL EXAMINE THE FEASIBILITY OF USING THESE PULSES AS A KNOWN SOURCE FOR DIRECT EVALUATION OF COUPLING COEFFICIENT AND EQUIVALENT ELASTIC SOURCE FUNCTION RADIUS IN HARD BRITTLE ROCK. THE PROPOSED WORK INCLUDES OBSERVATION OF SEISMIC SIGNALS PRODUCED BY AN EXISTING PULSE GENERATOR. THE DEMONSTRATION STUDY WILL EVALUATE THE EFFECTS OF PULSE ENERGY, RISE TIME, SOURCE ASYMMETRY, AND BURIAL DEPTH ON OBSERVED SEISMIC SIGNALS IN A WELL-CHARACTERIZED

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REINFORCED-CONCRETE BLOCK AND IN LARGE ANDESITE BOULDERS. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - THE PROPOSED TECHNIQUE PROVIDES A CONVENIENT MEANS OF GENERATING DATA ON SEISMIC COUPLING OF HARD ROCK EXPLOSIVE PULSES. THIS TECHNIQUE MAY BE APPLIED IN A LABORATORY AND FIELD PROGRAM TO OBTAIN COUPLING DATA IN HARD ROCK FORMATIONS SIMILAR TO THOSE FOUND IN THE SOVIET UNION AND IN THE UNITED STATES. COMPARISON OF THIS INFORMATION WITH DATA FROM NUCLEAR EXPLOSIONS WILL ALLOW BETTER DISCRIMINATION OF TELESEISM SOURCES. KEY WORDS - SEISMIC, COUPLING, NUCLEAR, EXPLOSION, HYDRAULIC, TELESEISM, TEST BAN, VERIFICATION

SUNBURST RECOVERY, INC.

P.O. BOX 2129

STEAMBOAT SPRINGS, CO 80477

Program Manager: CHAPMAN YOUNG

Contract #:

Title: EXPERIMENTAL DETERMINATION OF SEISMIC COUPLING IN HARD ROCK

Topic #: DARPA90-046

Office:

ID #: 50507

TECHNICAL ABSTRACT - SUPPORT OF EXISTING AND PROPOSED NUCLEAR TEST BAN TREATIES WILL REQUIRE IMPROVED METHODS FOR UNDERSTANDING AND PREDICTING THE SEISMIC COUPLING OF NUCLEAR DETONATIONS. PROPERLY DESIGNED AND EXECUTED SMALL AND INTERMEDIATE-SCALE EXPERIMENTS COULD SERVE TO DELIMIT THE IMPORTANCE OF ROCK AND TEST BED PROPERTIES UPON SEISMIC COUPLING. THE DATA FROM SUCH TESTS WOULD PROVIDE A BETTER BASIS FOR PREDICTING THE SEISMIC RESPONSE OF FULL-SCALE TEST SITES. SMALL-SCALE EXPERIMENTAL TECHNIQUES ALLOWING FOR SIGNIFICANT CONFINING OR OVERBURDEN PRESSURES WILL BE DEVELOPED TO TEST A VARIETY OF ROCK TYPES, STRUCTURES AND DECOUPLING CONDITIONS. AS THE MEASUREMENT OF ROCK RESPONSE WILL BE A CRITICAL ELEMENT OF SMALL AND INTERMEDIATE-SCALE TESTING, CONSIDERABLE EFFORT WILL BE DEVOTED TO DEVELOPING ELECTROMAGNETIC VELOCITY GAGE TECHNIQUES. ELECTROMAGNETIC GAGE TECHNIQUES ARE IDEALLY SUITED FOR SUCH MEASUREMENTS AS GAGE OUTPUT DEPENDS DIRECTLY UPON FARADAY'S LAW OF INDUCTION RATHER THAN UPON AN INDEPENDENTLY DETERMINED AND POSSIBLY TEST DEPENDENT CALIBRATION FACTOR. BOTH SMALL-SCALE LABORATORY AND INTERMEDIATE-SCALE FIELD TESTS WOULD BE CONDUCTED TO DEMONSTRATE THE CAPABILITIES OF THE TECHNIQUES. THE RESULTING DATA WOULD DEFINE THOSE AREAS IN WHICH MATERIAL PROPERTIES, SITE GEOMETRY AND OVERBURDEN PRESSURE CAN INFLUENCE SEISMIC COUPLING AND WOULD PROVIDE THE BASIS AND SCOPE FOR POSSIBLE PHASE II EFFORTS. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - THE EXPERIMENTAL TECHNIQUES DEVELOPED WOULD ALLOW FOR THE QUANTITATIVE EVALUATION OF THE ROLES OF OVERBURDEN PRESSURE, FLUID SATURATION, YIELDING AND COMPACTION UPON THE SEISMIC COUPLING OF HIGH-EXPLOSIVE AND NUCLEAR DETONATIONS. THE RESULTS WOULD SUPPORT EFFORTS TO VERIFY EXISTING AND PROPOSED TEST BAN TREATIES. THE TECHNIQUES WOULD ALSO BE APPLICABLE TO THE STUDY OF EXPLOSIVE COUPLING AND ROCK FRAGMENTATION IN COMMERCIAL BLASTING OPERATIONS.

APPLIED RESEARCH ASSOCIATES, INC.

4300 SAN MATEO NE, SUITE B380

ALBUQUERQUE, NM 87110

Program Manager: SCOTT BLOUIN

Contract #:

Title: EXPERIMENTAL EVALUATION OF THE INFLUENCE OF SITE LAYERING AND BURST DEPTH ON RADIATED SEISMIC ENERGY

Topic #: DARPA90-047

Office:

ID #: 50433

TECHNICAL ABSTRACT - THE FUNDAMENTAL OBJECTIVE OF THIS RESEARCH EFFORT IS TO EXPERIMENTALLY DETERMINE THE PHYSICAL PROCESS GOVERNING FORMATION OF GUIDED WAVES IN GEOLOGIES HAVING A LOW IMPEDANCE LAYER ATOP A HIGH IMPEDANCE LAYER AND TO DETERMINE THE

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INFLUENCE OF DEPTH OF BURIAL ON THESE PHYSICAL PROCESSES AND THE RESULTING RADIATED SEISMIC ENERGY. THE EXPERIMENTAL APPROACH WILL BE TO FIELD A SERIES OF SMALL SCALE HE EXPERIMENTS AT DIFFERENT DEPTHS OF BURIAL IN A TWO LAYERED (SOFT ROCK OVER HARD ROCK) GEOLOGY WITH GROUND MOTION INSTRUMENTATION EXTENDING FROM IMMEDIATELY ADJACENT TO THE EXPLOSIVE CHARGE TO WELL OUT IN THE LINEAR REGIME BEYOND THE RANGE OF FULL GUIDED WAVE DEVELOPMENT. IN THIS MANNER THE DEVELOPMENT OF REGIONAL PHASES WILL BE EXPERIMENTALLY MODELED. THE INSTRUMENTATION WILL PROVIDE FULL DEFINITION OF THE MOTIONS IN BOTH THE NONLINEAR AND LINEAR REGIMES AGAINST WHICH TO BENCHMARK FUTURE THEORETICAL WORK ON GUIDED WAVE DEVELOPMENT. THE PHASE I EFFORT WILL PROVIDE AN APPROPRIATE SITE FOR THESE EXPERIMENTS, VALIDATION OF THE EXPERIMENTAL TECHNIQUES TO INSURE HIGH CONFIDENCE IN THE SUCCESS OF THE PHASE II WORK, AND A LIMITED INITIAL DATA SET IN A LAYERED ROCK GEOLOGY. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - THIS RESEARCH WILL PERMIT MORE ACCURATE DETERMINATION OF NUCLEAR WEAPON TEST YIELDS AND ENHANCE DISCRIMINATION CAPABILITIES. KEY WORDS - ROCK DYNAMICS, UNDERGROUND NUCLEAR TESTING, SEISMIC COUPLING, EXPLOSION MECHANICS, GROUND MOTION, VERIFICATION/MONITORING.

ENSCO INC  
5400 PORT ROYAL RD  
SPRINGFIELD, VA 22151  
Program Manager: ZOLTAN DER  
Contract #:

Title: EXPERIMENTAL DETERMINATION OF THE EXCITATION OF SEISMIC REGIONAL PHASES AS A FUNCTION OF EXPLOSIO...

Topic #: DARPA90-047

Office:

ID #: 50420

TECHNICAL ABSTRACT - THIS PROJECT WILL CONSIST OF CONSTRUCTING 3D LABORATORY ACOUSTIC MODELS OF THE EARTH'S CRUST WITH DEPTH DEPENDENT Q, IMBEDDED HETEROGENEITIES AND OPTIONALLY, INTERFACE AND SURFACE TOPOGRAPHY. THESE MODELS WILL BE USED IN EXPERIMENTS FOR INVESTIGATING THE DEPTH DEPENDENCE OF THE PROPERTIES OF REGIONAL SEISMIC ARRIVALS PN, PG, SN AND LG, SUCH AS RELATIVE PHASE AMPLITUDES, SPECTRAL AND ENVELOPE SHAPES AND CODA PROPERTIES. THE RESULTS WILL BE COMPARED TO THOSE OBTAINED FROM THEORETICAL CALCULATIONS USING EITHER LINEAR FINITE-DIFFERENCE METHODS AND ANALYTICAL TECHNIQUES AND OBSERVATIONAL FINDINGS. THE EFFECTS OF NEAR-SOURCE NONLINEARITIES WILL ALSO BE SIMULATED BY IMPLEMENTING EQUIVALENT LINEAR MODELS. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - THE PROPOSED WORK HAS DIRECT APPLICATIONS TO THE REGIONAL DISCRIMINATION PROBLEM IN MONITORING OF NUCLEAR TESTING BY FOREIGN POWERS BY THE U.S. DEPARTMENT OF DEFENSE. THE FINDINGS OF THIS PROJECT WILL BE DIRECTLY USED IN PROCEDURES FOR DETERMINING THE DEPTH OF SEISMIC EVENTS OBSERVED AT REGIONAL DISTANCES AT DARPA-SPONSORED SEISMIC ARRAY OBSERVATORIES (NORESS, FINESA, ARCESS) AND ANY FUTURE MONITORING ARRAYS POSSIBLY INSTALLED IN THE USSR. KEY WORDS - SEISMOLOGY, ACOUSTIC, MODELING, CRUST, SCATTERING.

LNR COMMUNICATIONS, INC.  
180 MARCUS BOULEVARD  
HAUPPAUGE, NY 11788  
Program Manager: ROBERT GORDON  
Contract #:

Title: APPLICATIONS OF ACT TECHNOLOGY

Topic #: DARPA90-048

Office:

ID #: 50474

TECHNICAL ABSTRACT - PRESENT AND FUTURE ESM RECEIVING SYSTEMS MUST BE CAPABLE OF PROVIDING FINE-FREQUENCY-RESOLUTION SYNTHESIZED TUNING, SWITCHED-BANDWIDTH AND/OR CENTER FREQUENCY PREDETECTION IF AND/OR POSTDETECTION BASEBAND FILTERING AND TRANSVERSAL EQUALIZATION AND PROGRAMMABLE TIME DELAY IN THE TRANSMISSION PATHS OF ALL SIGNALS OF

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INTEREST IN ORDER TO INTERCEPT SIGNALS OF UNKNOWN CHARACTERISTICS IN A DISADVANTAGED CARRIER TO NOISE ENVIRONMENT. NOTING THE ABILITY OF ACOUSTIC CHARGE TRANSPORT (ACT) MONOLITHIC GAAS-BASED DEVICE TO SERVE AS EITHER A TAPPED VARIABLE ANALOG DELAY LINE, ANALOG MEMORY, VARIABLE BANDWIDTH AND/OR CENTER FREQUENCY BPF OR PROGRAMMABLE TRANSVERSAL EQUALIZER, A SIX MONTH SBIR STUDY IS PROPOSED TO INVESTIGATE IN DETAIL THE APPLICATION OF PRESENT AND PROJECTED ACT DEVICES TO SUCH ESM RECEIVER ANALOG IF SIGNAL PROCESSING FUNCTIONS AS PREDETECTION BANDPASS FILTERING, CORRELATION DETECTION, POSTDETECTION BASEBAND FILTERING, ETC. AS SUCH, THE PROPOSED PROGRAM WILL CULMINATE IN THE DESIGN OF AN ADVANCED ESM RECEIVER WHICH UTILIZES ACT DEVICES TO PROVIDE AN OPTIMUM COMBINATION OF THE FOREGOING SIGNAL PROCESSING FUNCTIONS. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - THE ADVANCED ACT-BASED ESM RECEIVER DESIGN GENERATED DURING THE PROPOSED PHASE I STUDY WILL FORM THE BASIS FOR A PHASE II FOLLOW-ON DEVELOPMENT OF A FEASIBILITY MODEL ESM RECEIVER IF SIGNAL PROCESSOR INCORPORATING AN OPTIMUM "MIX" OF ACT TECHNOLOGY. THE SUCCESSFUL DEMONSTRATION OF THE LATTER, IN TURN, CAN LEAD TO THE MANUFACTURE AND DEPLOYMENT OF ACT-BASED ESM RECEIVER PRODUCTS BY THE U.S. NAVY, AS WELL AS ARMY, AIR FORCE AND OTHER GOVERNMENT AGENCIES. KEY WORDS - ACOUSTIC, CHARGE, TRANSPORT, DELAY LINE, PROGRAMMABLE FILTER, RECEIVER, SIGNAL PROCESSING.

SUBMARINE TECHNOLOGY ASSOCIATES

P.O. BOX 562

PORTSMOUTH, RI 02871

Program Manager: T. DEEGAN

Contract #:

Title: LF DETECTION OF AIRCRAFT

Topic #: DARPA90-049

Office:

ID #: 50506

TECHNICAL ABSTRACT - COMBAT RESOURCES ARE PRECIOUS COMODITIES THAT MUST USE EVERY DETECTION MEANS AT THEIR DISPOSAL TO DETECT THE INCREASINGLY WILEY THREAT. ACTIVE DETECTION PROCESSES GIVE AWAY THE PRESENCE OF THE SEARCHER AND ATTRACT FIRE. PASSIVE DETECTION TECHNIQUES RELY ON OBSERVABLE CHARACTERISTICS THAT, IN THE CASE OF RADARS AND COMMUNICATIONS EMISSIONS, CAN BE SILENCED AT THE DISCRETION OF THE THREAT. THE PROPOSED EFFORT EVALUATES THE FEASIBILITY OF A DETECTION MECHANISM THAT DETECTS RADIO FREQUENCY EMISSIONS THAT ARE AN INDIRECT PRODUCT FROM JET AND ROCKET COMBUSTION CHAMBERS. THE SOURCE IS DIFFICULT TO SUPPRESS. MODERN SIGNAL PROCESSING TECHNIQUES NORMALLY ASSOCIATED WITH SONARS CAN MAKE THIS A VIABLE MECHANISM FOR DETECTING AIRCRAFT AND MISSILES BEYOND THE SIGHT HORIZON. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - THE PROPOSED PASSIVE DETECTION PROCESS ENHANCES THE SURVIVABILITY OF COMBAT UNITS AND ALLOWS THEM TO DETECT APPROACHING HELICOPTERS, ROCKET-PROPELLED MISSILES, AND GAS-TURBINE DRIVEN VEHICLES. KEY WORDS -

ADVANCED SURFACE TECHNOLOGY, INC.

12 CLEMATIS AVENUE

WALTHAM, MA 02154

Program Manager: IH-HOUNG LOH

Contract #:

Title: THIN PLASTIC FILMS WITH ELECTRICALLY CONTROLLABLE REFLECTIVITY/TRANSMISSIVITY TO VISUAL OR INFRARED

Topic #: DARPA90-050

Office:

ID #: 50344

TECHNICAL ABSTRACT - THIN FILM MATERIALS CONSISTING OF RANDOM DISPERSION OF NEMATIC LIQUID-CRYSTAL MICRODROPLETS EMBEDDED IN AN ISOTROPIC TRANSPARENT POLYMERIC MEDIA (OR CALLED POLYMER DISPERSED LIQUID CRYSTALS (PDLC)) HAVE RECENTLY BEEN DEVELOPED FOR USE IN OPTICAL AND ELECTRO-OPTICAL DEVICES. THESE THIN FILM MATERIALS ARE PROMISING CANDIDATES IN



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DISPLAY TECHNOLOGY WHICH CAN BE USED FOR FAST ELECTRICAL CONTROL OF THE VISUAL AND INFRARED SIGNATURES OF AIRCRAFTS, SHIPS, AND LAND VEHICLES. THE OPERATION OF SUCH SYSTEMS REQUIRES ONLY RELATIVELY LOW ELECTRIC VOLTAGE AND LOW POWER CONSUMPTION. IN ADDITION, THESE SYSTEMS HAVE A SATISFACTORY RESPONSE TIME (ABOUT 1 MS), PROVIDE REASONABLE CONTRAST, AND ARE RELATIVELY ECONOMICAL. PDLC IS COMBINED WITH NOVEL THIN FILM FABRICATION TECHNOLOGY TO PROVIDE THE ABILITY TO ELECTRICALLY CONTROL REFLECTIVITY AND TRANSMISSIVITY WITHIN THE VISUAL OR INFRARED RANGES. THE KEY ELEMENT IN THIS INNOVATIVE DESIGN IS THE FABRICATION OF TRANSPARENT PLASTIC FILMS WHICH CONTAIN SMALL DROPLETS OF NEMATIC LIQUID CRYSTALS. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - THE POTENTIAL COMMERCIAL APPLICATIONS FOR PDLC MATERIALS ARE EXPECTED IN THE AREAS OF LARGE AREA OPTOELECTRONIC DISPLAYS, THERMAL INDICATORS, OPTICAL COMPUTING, OPTICAL HARDENING, LIGHT VALVES, AND SOLAR CONTROL WINDOWS. KEY WORDS - LIQUID CRYSTALS, PLASTICS, REFLECTIVITY, TRANSMISSIVITY, ELECTRICALLY CONTROLLABLE

DAMASKOS, INC.

P.O. BOX 469

CONCORDVILLE, PA 19331

Program Manager: WILLIAM BITER

Contract #:

Title: SWITCHABLE LOW EMISSIVITY FILMS

Topic #: DARPA90-050

Office:

ID #: 50448

TECHNICAL ABSTRACT - DAMASKOS, INC. PROPOSES TO DEVELOP AND MODEL AN ADVANCED THIN FILM COATING SYSTEM TO LOWER THE IR SIGNATURE OF AN OBJECT. THIS FILM WILL BE CAPABLE OF RAPIDLY SWITCHING ITS INFRARED EMISSIVITY IN A CONTROLLABLE FASHION SO THAT THE THERMAL SIGNATURE OF THE OBJECT CAN BE CHANGED TO MATCH THAT OF THE BACKGROUND, EVEN IN THE CASE OF A RAPIDLY CHANGING BACKGROUND. THE CONDUCTION BAND INTERACTS WITH THE INFRARED RADIATION TO PRODUCE AN ABSORPTION OF THIS RADIATION. THE PREDICTED EMISSIVITY RANGE WOULD VARY FROM A FEW PERCENT IN THE "OFF" STATE, TO ABOUT 90% IN THE "ON" STATE AT A WAVELENGTH OF 10 MICRONS. THE ACTIVATION IS VIA ELECTRICALLY SWITCHED FIBER-OPTIC COUPLED LED'S OR LASERS AND THE SYSTEM WILL BE "QUIET," I.E, NOT RADIATING ANY DETECTIBLE ENERGY. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - THE SYSTEM WILL PROVIDE THE MILITARY WITH THE CAPABILITY OF LOWERING THE THERMAL SIGNATURE OF A VEHICLE. THIS INCREASES THE ABILITY OF THIS VEHICLE TO ACCOMPLISH ITS MISSION. NO COMMERCIAL APPLICATIONS HAVE BEEN IDENTIFIED. KEY WORDS - IR SIGNATURE, THERMAL, PHOTOCONDUCTIVE, FIBER-OPTICS.

DISPLAY SCIENCE, INC.

189 BEAVER STREET, P.O. BOX 72

NORTH ADAMS, MA 01247

Program Manager: CHARLES BRIGGS, JR.

Contract #:

Title: ELECTRICALLY CONTROLLABLE REFLECTIVITY/TRANSMISSIVITY OF VISUAL AND INFRARED WITH COATED THIN FILM

Topic #: DARPA90-050

Office:

ID #: 50450

TECHNICAL ABSTRACT - AN INTRODUCTION TO A NEW REFLECTIVITY/TRANSMISSIVITY CONTROL TECHNOLOGY USING COATED THIN FILM THAT IS ELECTRICALLY CONTROLLABLE IS OFFERED. DURING PHASE I OF THE CONTRACT, A DEFINITION OF THE DESIRED REFLECTIVITY/TRANSMISSIVITY CHARACTERISTICS FOR EVALUATION WILL BE ESTABLISHED. DSI WILL SELECT SUITABLE MATERIALS BASED ON THEIR PHYSICAL AND ELECTRICAL PROPERTIES FOR TESTING AND DEMONSTRATION PURPOSES. PRODUCTION FEASIBILITY STUDY AND COST ANALYSIS WILL BE PERFORMED. POTENTIAL APPLICATIONS AND SUITABLE FABRICATION TECHNIQUES FOR SUCH APPLICATIONS WILL BE ESTABLISHED. DATA

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REQUIRED BY DARPA WILL BE AVAILABLE AT THE END OF THE CONTRACT. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - THE RESULTS OF THIS EVALUATION HAVE EXCELLENT POTENTIAL FOR APPLICATION AS AN ECONOMIC MEANS OF ENERGY CONSERVATION AND IN THE DISPLAY FIELD. KEY WORDS - WINDOW; LIGHT; INFRARED; REFLECTIVITY; TRANSMISSIVITY; ELECTRONICALLY; CONTROLLABLE; THERMAL.

E-TEK DYNAMICS, INC.  
1885 LUNDY AVENUE  
SAN JOSE, CA 95131  
Program Manager: J. PAN

Contract #:

Title: THIN FILMS WITH ELECTRICALLY CONTROLLABLE REFLECTIVITY/TRANSMISSIVITY TO VISUAL OR INFRARED

Topic #: DARPA90-050

Office:

ID #: 50452

TECHNICAL ABSTRACT - MODERN WARFARE VESTMENTS AND RELATED DEFENSES REQUIRE ADVANCED PROTECTION TECHNOLOGIES. A LIGHTWEIGHT THIN FILM WITH ELECTRICALLY CONTROLLABLE REFLECTIVITY/TRANSMISSIVITY TO VISUAL OR INFRARED RADIATION CAN BE USEFUL IN REACHING THIS GOAL. HOWEVER, SUCH THIN FILM IS NOT AVAILABLE NOW. E-TEK PROPOSES TO DESIGN AN INNOVATIVE THIN FILM WITH WIDE REFLECTIVITY/TRANSMISSIVITY TUNABLE RANGE BY LOW ELECTRIC POWER, USING SPECIALLY SELECTED ELECTRO-OPTIC MATERIALS AND SPECIALLY DESIGNED ELECTRODES. THE NEW THIN FILM WILL HAVE THE ADVANTAGES OF SIMPLE STRUCTURE, LOW COST, LIGHTWEIGHT ( $< 1$  OUNCE/SQUARE FOOT), DURABILITY, WIDE REFLECTIVITY/TRANSMISSIVITY TUNING RANGE ( $0.05 < R < 0.8$ ), LOW TUNING POWER ( $< 10$  MW), AND PLIANCY. IN ADDITION TO THE THEORETICAL ANALYSIS OF PROPOSED THIN FILM PERFORMANCE PARAMETERS, A PRACTICAL THIN FILM OF ONE SQUARE FOOT AND LESS THAN ONE OUNCE WILL BE DESIGNED AND FABRICATED DURING PHASE I TO DEMONSTRATE THE FEASIBILITY, VIABILITY, AND TUNABILITY. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - LASER SENSOR PROTECTOR, INFRARED RADIATION FOR ENERGY SAVING, INFRARED INTRUDER ALARM, TUNABLE RUGATE FILTER. KEY WORDS - ELECTRICALLY CONTROLLABLE REFLECTIVITY/TRANSMISSIVITY THIN FILM ELECTRO-OPTIC MATERIALS.

EIC LABORATORIES, INC.  
111 DOWNEY STREET  
NORWOOD, MA 02062  
Program Manager: R. RAUH

Contract #:

Title: VARIABLE EMITTANCE COATINGS FOR INFRARED SIGNATURE SUPPRESSION

Topic #: DARPA90-050

Office:

ID #: 50453

TECHNICAL ABSTRACT - A PROGRAM TO DEVELOP VARIABLE EMITTANCE COATINGS FOR INFRARED SIGNATURE SUPPRESSION IS PROPOSED. THE COATINGS WOULD ALLOW ACTIVE MODULATION OF THE IR EMITTANCE OR REFLECTANCE OF SURFACES BY THE APPLICATION OF A LOW VOLTAGE ( $< 3$  V) DC ELECTRIC CURRENT. BOTH MID-INFRARED (2-16  $\mu$ M) EMITTANCE MODULATION AND NEAR-INFRARED (0.7-2.0  $\mu$ M) REFLECTANCE MODULATION CAN BE OBTAINED WITH VARIOUS COATING CONFIGURATIONS, PROVIDING COUNTERSURVEILLANCE AGAINST THERMAL SENSORS AND NIGHT-VISION DEVICES. THE EXITANCE (THERMAL EMISSION AND REFLECTED RADIANT ENERGY) FROM A COATED SURFACE CAN BE VARIED IN RESPONSE TO INFRARED SURVEILLANCE THREATS UNDER DIFFERENT OPERATING CONDITIONS AND AGAINST DIFFERENT INFRARED BACKGROUNDS. THE VARIABLE EMITTANCE COATINGS ARE BASED ON ELECTROCHROMIC OPTICAL SWITCHING IN THIN FILMS OF TRANSITION METAL OXIDES. THE EMITTANCE MODULATION IS OBTAINED BY VARYING THE INFRARED REFLECTANCE (OR ABSORPTANCE) OF AN ELECTROCHROMIC MATERIAL THAT OVERLAYS AN EMISSIVE (OR REFLECTIVE) SUBSTRATE. THE EMITTANCE WOULD BE ACTIVELY AND REVERSIBLY MODULATED, REQUIRING 0.1 W-HR/M<sup>2</sup> FOR FULL

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EMITTANCE SWITCHING. A PROTOTYPE EMITTANCE MODULATION OF 0.2-0.8 IS ANTICIPATED OVER THE 0.7-16 UM WAVELENGTH RANGE. THE OBJECTIVE OF THE PHASE I PROGRAM IS TO ESTABLISH THE PERFORMANCE OF THE PROPOSED VARIABLE REFLECTANCE ELECTROCHROMIC MATERIALS AND FABRICATE AND CHARACTERIZE A PROTOTYPE VARIABLE EMITTANCE COATING. THE PHASE II PROGRAM WOULD SEEK TO OPTIMIZE VARIABLE EMITTANCE COATINGS AND FABRICATE A 1 FT<sup>2</sup> PROTOTYPE BY COMMERCIALY ACCEPTABLE DEPOSITION PROCESSES SUITABLE FOR COATING LARGE AREAS. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - VARIABLE EMITTANCE COATINGS WILL PROVIDE INFRARED SIGNATURE SUPPRESSION IN REAL-TIME UNDER DIVERSE MISSION CONDITIONS. THE COATINGS ARE APPLICABLE TO AIR, SEA, SPACE AND GROUND-BASED MILITARY COMPONENTS. BESIDES COUNTERSURVEILLANCE APPLICATIONS, VARIABLE EMITTANCE COATINGS COULD FIND COMMERCIAL APPLICATION AS THERMAL CONTROL SURFACES ON

GEO-CENTERS, INC.

7 WELLS AVENUE

NEWTON CENTRE, MA 02159

Program Manager: MARY TABACCO

Contract #:

Title: THIN FILMS FOR ELECTRICALLY CONTROLLABLE OPTICAL SIGNATURE

Topic #: DARPA90-050

Office:

ID #: 50463

TECHNICAL ABSTRACT - A NEED PRESENTLY EXISTS WITHIN THE DARPA ARMOR/ANTIARMOR PROGRAM FOR THE DEVELOPMENT OF LIGHTWEIGHT SURFACE MODIFICATION TECHNOLOGIES TO ALLOW CONTROL AND MODIFICATION OF THE VISUAL AND INFRARED OPTICAL SIGNATURES OF AIRCRAFT, SHIPS, AND LAND VEHICLES. GEO-CENTERS, INC. PROPOSES A MULTIPHASE PROGRAM TO DEVELOP ELECTROCHROMIC TECHNOLOGY TO MEET THESE REQUIREMENTS. USING THIS APPROACH, GEO-CENTERS, INC., IN COLLABORATION WITH TUFTS UNIVERSITY, HAS BEEN RESEARCHING AND DESIGNING ELECTROCHROMIC THIN FILM DEVICES TO DEVELOP, "SMART WINDOWS" WHOSE OPTICAL PROPERTIES CHANGE WITH THE APPLICATION OF AN ELECTRIC CURRENT. IN PHASE I, A PROGRAM IS PROPOSED TO IDENTIFY AND QUANTIFY MATERIALS PARAMETERS SPECIFIC TO ELECTROCHROMIC DEVICES, WHICH CAN BE MODIFIED AND TAILORED TO MEET THIS APPLICATION. THIN FILM PROCESSING DEVICE FABRICATION TECHNIQUES AND COST ANALYSIS WILL ALSO BE PERFORMED. IN PHASE II, SCALED UP PANELS (> 1 SQUARE FOOT) WILL BE FABRICATED AND THEIR EFFICIENCY WILL BE DETERMINED IN TERMS OF DEGREE OF MODULATION AND POWER CONSUMPTION. ELECTROCHROMIC PANELS SUITABLE FOR SMALL SCALE PHASE III PRODUCTION WILL BE RECOMMENDED. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - THIS ELECTROCHROMIC TECHNOLOGY AND THE PROTOTYPE DEVICES ONCE DEVELOPED WILL FIND APPLICATION THROUGHOUT DOD WHEREVER STEALTH IS REQUIRED. THIS TECHNOLOGY ALSO HAS GREAT COMMERCIAL POTENTIAL IN THE AREA OF ENERGY CONSERVING "SMART WINDOWS," DISPLAY AND IMAGING APPLICATIONS, AND ELECTROCHROMIC MIRRORS TO IMPROVE SAFETY IN AUTOMOBILES, SKYSCRAPERS, AND OTHER APPLICATIONS. KEY WORDS - OPTICAL SIGNATURE, ELECTROCHROMISM, THIN FILMS.

GUMBS ASSOCIATES, INC.

11 HARTS LANE

EAST BRUNSWICK, NJ 08816

Program Manager: PRASANNA SEKHAR

Contract #:

Title: SOLUBLE CONDUCTING POLYMER BASED THIN FILMS WITH ELECTRICALLY CONTROLLABLE VISIBLE/IR SIGNATURE

Topic #: DARPA90-050

Office:

ID #: 50465

TECHNICAL ABSTRACT - VERY RECENT UNRELATED WORK AT GUMBS HAS YIELDED SIGNIFICANT DEVELOPMENTS IN CONDUCTING POLYMER TECHNOLOGY, WITH PROCESSIBLE POLYMERS WITH 8 W/W% OR HIGHER SOLUBILITY IN ORGANIC SOLVENTS, CONTROLLABLE CONDUCTIVITY, LOW SIGNATURE

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(EMISSION AND REFLECTANCE) IN THE 0.35  $\mu$  TO 12  $\mu$  REGION (DATA PRESENTED HEREIN) CONTROLLABLE VIA DOPING LEVEL. THE POLYMERS HAVE PROVEN PROCESSIBILITY AS THIN FILMS AND ENVIRONMENTAL STABILITY. THE PROPOSED WORK WILL SEEK TO USE THESE NOVEL POLYMERS DEPOSITED FROM SOLUTION ONTO CONDUCTING SUBSTRATES FOR FABRICATION OF LARGE-AREA PANELS WITH THIN, IR AND VISIBLE REGION TRANSPARENT ENCAPSULANTS OR ALONE WITH SOLID ELECTROLYTES. USE OF FLEXIBLE PLASTIC SUBSTRATES WILL ALSO ENABLE APPLICATION TO ODD-SHAPED OBJECTS. TRANSMISSIVITY AND REFLECTANCE MEASUREMENTS ON SAMPLES WITH A NUMBER OF VARIABLES INCLUDING POLYMER TYPE AND THICKNESS AND ENCAPSULANT TYPE SHOULD ESTABLISH THE FEASIBILITY OF THE TECHNOLOGY DURING PHASE I. ADVANTAGES OF THE TECHNOLOGY, BESIDES LOW AND CONTROLLABLE VISIBLE/IR SIGNATURE, INCLUDE CHEMICAL DURABILITY, LIGHT WEIGHT AND LOW COST. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - IF THE PROJECT IS SUCCESSFUL, IN ADDITION TO THE ENVISIONED APPLICATION AS LOW TRANSMISSIVITY/REFLECTANCE MATERIALS, APPLICATIONS INCLUDE WHEREVER CONDUCTIVE COATINGS ARE REQUIRED, INCLUDING FOR SUCH USES AS RADAR SIGNATURE REDUCTION, ODD-SHAPED ELECTRODES FOR BATTERIES, ELECTROCHROMIC DISPLAYS, AND ULTRA-FAST ELECTRO-OPTIC SWITCHES. KEY WORDS - SOLUBLE; CONDUCTING; POLYMER; CONTROLLABLE; TRANSMISSIVITY; REFLECTANCE.

PHYSICAL OPTICS CORP  
2545 W 237TH ST - STE B  
TORRANCE, CA 90505

Program Manager: DR GAJENDRA SAVANT

Contract #:

Title: LARGE FABRY-PEROT COATING WITH TUNABLE/VARIABLE REFLECTIVITY OR TRANSMISSIVITY

Topic #: DARPA90-050

Office:

ID #: 50397

TECHNICAL ABSTRACT - PHYSICAL OPTICS CORPORATION (POC), PROPOSES TO DEVELOP A OF HOLOGRAPHIC FABRY-PEROT COATING (HFPC) AS A MEANS OF CONTROLLING THE VISIBLE AND INFRARED SIGNATURES OF COMBAT VEHICLES. THIS NEW TECHNIQUE OF HFPC COMBINES POC'S COHERENTLY COUPLED BRAGG/LIPPMANN HOLOGRAPHIC TECHNOLOGY AND ELECTRO-OPTIC MATERIAL TECHNOLOGY AS AN EFFECTIVE METHOD FOR CONTROLLING TRANSMISSIVITY AND REFLECTIVITY OF THE VEHICLE SURFACE. POC'S FABRY-PEROT COATING TECHNOLOGY HAS ALREADY BEEN PROVEN TO HAVE SEVERAL ADVANTAGES OVER OTHER TECHNOLOGIES INCLUDING: LARGE SIZE, LOW VOLTAGE TUNABILITY, HIGH FINESSE, AND BROAD TUNABILITY. SINCE BRAGG/LIPPMANN OPTICAL PLANES FOLLOW THE DIPS AND VALLEYS OF THE SUBSTRATE SURFACE, HFPC IS COMPATIBLE WITH AIRPLANE AND SHIP SURFACES. IN ADDITION, USE OF FAST SWITCH ELECTRO-OPTIC POLYMER RENDERS A HIGH SPEED RESPONSE ON THE ORDER OF A PICOSECOND. BECAUSE OF THE RUGGED NATURE OF HOLOGRAPHIC STRUCTURES INVOLVED IN THE COATING FABRICATION, POC'S HFPC IS LASER HARDENED IN ADDITION TO BEING HIGH TEMPERATURE STABLE. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - THE POTENTIAL APPLICATIONS FOR THIS TECHNOLOGY ARE LOW COST AND RUGGED HFPCS FOR VISIBLE/IR SIGNATURE CONTROL. ADDITIONAL APPLICATIONS WILL BE FOR HIGH CONTRAST SPATIAL LIGHT MODULATORS, OPTICAL SWITCHES FOR OPTICAL COMPUTING AND A WEIGHTED SYNAPSE FOR NEURAL NETWORKS. KEY WORDS - VISIBLE, INFRARED, SIGNATURE CONTROL, COATING, LOW VOLTAGE.

THERMONICS, INC.  
ROUTE #2, BOX 647-D  
SUTTONS BAY, MI 49682

Program Manager: RICHARD BUIST

Contract #:

Title: ELECTRICALLY CONTROLLABLE INFRARED SIGNATURE USING THERMOELECTRICS

Topic #: DARPA90-050

Office:

ID #: 50512

TECHNICAL ABSTRACT - HOT SPOTS ON TANKS AND OTHER MILITARY VEHICLES GIVE OFF LARGE, HIGH INTENSITY AND CHARACTERISTIC INFRARED SIGNALS WHICH CAN BE EASILY INTERPRETED AND LOCKED

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ONTO BY ADVERSARIAL WEAPONRY AND THERMAL IMAGERY. THE THERMOELECTRIC (TE) TEMPERATURE CONTROLLED PLATE TO BE DEVELOPED ON THE PROPOSED PROGRAM WILL DEMONSTRATE THE FEASIBILITY OF USING THIS TECHNOLOGY TO THERMALLY COVER HOT SPOTS OR ENTIRE VEHICLES. THIS PLATE WILL NOT ATTEMPT TO COOL THE VEHICLE, BUT TO PERFORM THE MORE PRACTICAL AND REALIZABLE TASK OF CREATING A "TEMPERATURE CONTROLLABLE" "THERMAL SHIELD." IT WILL CONTAIN AN ARRAY OF TE MODULES WHICH CAN BE INDIVIDUALLY CONTROLLED TO PRODUCE COLD OR HOT THERMAL PATTERNS AS WELL AS ISOTHERMS. THE POWER CAN BE ADJUSTED TO EXACTLY MATCH BACKGROUND TEMPERATURES AND RENDER THE PLATE THERMALLY INVISIBLE AND UNDETECTABLE BY THERMAL IMAGERY. THIS UNIT WILL BE THE FORERUNNER FOR THE MORE SOPHISTICATED THERMAL SHIELDS PLANNED FOR PHASE II MADE VIA A PLASMA-SPRAY PROCESS. IRREGULAR SHAPED PATTERNS MUCH LIKE VISUAL CAMOUFLAGE PAINT PATTERNS WILL CREATE CONTROLLABLE AND DYNAMICALLY CHANGEABLE THERMAL IMAGES. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - THE THERMAL SHIELDS DEVELOPED ON THIS PROGRAM WILL NOT ONLY BE USABLE FOR DISGUIISING VEHICLES OR OTHER OBJECTS IT MAY COVER, BUT THERMAL PATTERNS OR TIMED SEQUENCES OF THERMAL PATTERNS, SIMILAR TO "BAR CODES," COULD BE USED TO IDENTIFY "FRIEND OR FOE." THE ADVANCED PLASMA-SPRAYED TECHNOLOGY PLANNED FOR PHASE II WILL CREATE A REVOLUTIONARY ADVANCE IN THE TE MANUFACTURING STATE-OF-THE-ART CREATING NEW COMMERCIAL APPLICATIONS TO HELP SUPPORT FURTHER DEVELOPMENT. KEY WORDS - THERMOELECTRIC COOLING TEMPERATURE CONTROL INFRARED

EPSILON LAMBDA ELECTRONICS CORP.  
427 STEVENS STREET  
GENEVA, IL 60134

Program Manager: KENNETH WOOD

Contract #:

Title: COVERT V-BAND COMMUNICATIONS ANTENNA TO IMPROVE OPERATIONAL CONTROL OF WIDE AREA MINES

Topic #: DARPA90-051

Office:

ID #: 50458

TECHNICAL ABSTRACT - ENHANCEMENTS TO EXISTING WIDE AREA MINE (WAM) SYSTEMS WHICH ENHANCE EFFECTIVENESS WITHOUT SIGNIFICANT COST INCREASE ARE SOUGHT. THE ADDITION OF MINEFIELD COMMAND AND CONTROL, C2, IS RECOGNIZED AS A MAJOR ENHANCEMENT TO MINEFIELD OPERATIONS. LOCALIZED COVERT COMMUNICATIONS USING THE HIGH ATMOSPHERIC ABSORPTION NEAR 60 GHZ (V-BAND) IS AN EMERGING IMPROVEMENT IN C2 CAPABILITY. THIS PROPOSAL DESCRIBES AN IMPORTANT POTENTIAL DEVICE IMPROVEMENT IN OPERATION OF V-BAND COMMUNICATION SYSTEMS. A RAPIDLY SCANNED, SECTORED ANTENNA AND TRANSCEIVER PROVIDES THE DESIRED ANTENNA PATTERN USING VERY RAPID BEAM SWITCHING. SYSTEM DYNAMIC RANGE IMPROVEMENT RESULTS IN DOUBLING OF RANGE (QUADRUPLE AREA INCREASE) WITH IMPROVED FOLIAGE PENETRATION. INTERMINE COMMUNICATION CAN BE MADE MORE COVERT BY BEAM SELECTION ALLOWING ESSENTIALLY SELECTIVE, TEMPORARY LINE-OF-SIGHT OPERATION. PHASE I RESEARCH WILL INVOLVE ANALYSIS OF IMPACT ON C2 EFFECTIVENESS, DETERMINATION OF OPTIMAL BEAM PATTERNS, DEMONSTRATION OF THE SCANNING SWITCH AND CONSIDERATION OF ANTENNA/TRANSCEIVER PACKAGING. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - PHASE I RESEARCH WILL PROVIDE A FOUNDATION FOR DEVELOPMENT DURING PHASE II OF A FORM FACTORED V-BAND SCANNING ANTENNA/TRANSCEIVER FOR INCLUSION IN FUTURE DARPA MINEFIELD COMMAND AND CONTROL PROGRAMS. THIS DEVICE COULD ENHANCE COMMUNICATION BETWEEN MANNED VEHICLES SUCH AS TANKS, RADAR INSTALLATIONS, HELICOPTERS AND OTHER AIRCRAFT FLYING IN FORMATION. KEY WORDS - MINEFIELD COMMUNICATION, WIDE AREA MINES, COVERT COMMUNICATIONS, SCANNING ANTENNA.

SESCO/MIRAGE SYSTEMS  
537 LAKESIDE DRIVE  
SUNNYVALE, CA 94086  
Program Manager: JAMES HARRIS

**SMALL BUSINESS INNOVATION RESEARCH PROGRAM - PHASE I**  
**DARPA Solicitation 90.1**

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**Contract #:**

**Title:** SW&RM MINES FOR AIRBASE DENIAL AND FOR MOBILE AIR PERIMETER DEFENSE OF SPECIAL OPERATION FORCES

**Topic #:** DARPA90-051

**Office:**

**ID #:** 50501

**TECHNICAL ABSTRACT -** HIGHLY EFFECTIVE, LOW COST, FORCE MULTIPLIER WIDE AREA BRILLIANT MINES ARE FEASIBLE USING PROPRIETARY SMART WEAPON ADJUSTABLE ASPECT AND RANGING MUNITION (SW&RM) TECHNOLOGY. THESE MINES OFFER THE POTENTIAL FOR INDEFINITE CLOSURE OF ENEMY OPERATING BASES AND OFFER AN EFFECTIVE MOBILE SCREEN FOR SOF FORCES AGAINST INTERDICTING THREAT AIRCRAFT AND WEAPONS. THE RESEARCH FOCUSES ON: ACOUSTIC DETECTION, POSITIVE C3I INTERVENTION, DORMANT POWER, DESIGNATION OF TARGETS, SPECTRUM AND MOTION ESTIMATION, TARGET ENTRAPMENT AND AUTONOMOUS FIRE CONTROL. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - AIR SUPERIORITY IN KOREA, ETC.; HIGHLY EFFECTIVE SOF VERTICAL MINE FIELDS AGAINST AIRCRAFT/WEAPONS. KEY WORDS - AIR SUPERIORITY, VERTICAL PERIMETER DEFENSES, C3I INTERVENTION, THREAT ENTRAPMENT, SPECTRUM AND MOTION ESTIMATION, ACOUSTIC DETECTION, AUTONOMOUS FIRE CONTROL.

**QUANTIC INDUSTRIES, INC.**

**990 COMMERCIAL STREET**

**SAN CARLOS, CA 94070**

**Program Manager: L. ELMORE**

**Contract #:**

**Title:** THE USE OF ACTIVE MATERIALS TO ENHANCE FRAGMENT-IMPACT INITIATION OF EXPLOSIVES

**Topic #:** DARPA90-052

**Office:**

**ID #:** 50493

**TECHNICAL ABSTRACT -** FRAGMENTING WARHEAD EFFECTIVENESS IN DETONATING COVERED EXPLOSIVES CAN BE SIGNIFICANTLY ENHANCED IF THE FRAGMENTS DISPERSED BY THE WARHEAD ARE REACTIVE, I.E., IF THEY INITIATE EXPLOSIVE MATERIALS IN THE TARGET OTHER THAN BY MEANS OF KINETIC ENERGY. TWO PROBLEM AREAS IN PRIOR REACTIVE FRAGMENT DEVELOPMENT HAVE BEEN THE HANDLING AND CONTAINMENT OF REACTANTS IN THE WARHEAD FRAGMENT AND THE ABILITY OF THE FRAGMENTS TO PENETRATE TARGETS WITHOUT DISINTEGRATING. THE PROPOSED DEVELOPMENT WILL SOLVE THESE PROBLEMS. THE PROPOSED FRAGMENT BODY WILL BE MADE FROM A NEW TUNGSTEN ALLOY THAT ELIMINATES PROBLEMS WITH FRAGMENT DISINTEGRATION UPON HARD TARGET IMPACT. ALTERNATIVELY, THE REACTIVE MATERIALS WILL BE INGESTED INTO THE TARGET BY JET ACTION FROM SMALL SHAPED CHARGES. THE REACTIVE MATERIAL CONTAINS EXCESS OXIDIZER, WHICH IS USED TO SUPPORT COMBUSTION IN THE COVERED EXPLOSIVE. REACTIVE MATERIALS HAVE BEEN SELECTED TO PROVIDE SATISFACTORY SAFETY AND HANDLING CHARACTERISTICS. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - A SUCCESSFUL REACTIVE FRAGMENT DEVELOPMENT PROGRAM WILL RESULT IN SIGNIFICANTLY IMPROVED FRAGMENTING WARHEAD EFFECTIVENESS FOR DETONATING COVERED EXPLOSIVES. KEY WORDS - FRAGMENTS, REACTIVE, TUNGSTEN, WARHEAD, INCENDIARY.

**PHYSICAL OPTICS CORP**

**2545 W 237TH ST - STE B**

**TORRANCE, CA 90505**

**Program Manager: DR FREDDIE LIN**

**Contract #:**

**Title:** MULTIPLEXED BINARY OPTICAL ELEMENTS FOR OPTICAL PROCESSING APPLICATIONS

**Topic #:** DARPA90-053

**Office:**

**ID #:** 50353

**TECHNICAL ABSTRACT -** PHYSICAL OPTICS CORPORATION (POC) IS PROPOSING A NOVEL APPROACH TO BINARY OPTICAL PROCESSING APPLICATIONS USING MULTIPLEXED BINARY OPTICAL ELEMENTS (MBOES). MBOES NOT ONLY PRESERVE THE PROPERTIES THAT CONVENTIONAL THIN BINARY OPTICAL ELEMENTS

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HAVE, SUCH AS LOW COST, LIGHT WEIGHT, MONOLITHIC CONFIGURATION, DESIGN FLEXIBILITY AND ABERRATION-FREE OPERATION, BUT ALSO PROVIDE TWO UNIQUE CHARACTERISTICS: HIGH DIFFRACTION EFFICIENCY AND MULTIPLEXING CAPABILITY. MBOES COMBINE THE ADVANTAGES OF COMPUTER GENERATED HOLOGRAPHY AND THICK BRAGG HOLOGRAPHIC TECHNOLOGY. THE BENEFITS OF MBOES CAN BE REALIZED IN BOTH OPTICAL WAVEGUIDES AND IN FREE SPACE. IN OPTICAL WAVEGUIDE OPERATIONS, ONLY 2D BINARY PATTERNS ARE REQUIRED AND THE FABRICATION OF WAVEGUIDE MBOES WOULD INCLUDE WRITING PATTERNS DIRECTLY ONTO THE WAVEGUIDE. IN FREE SPACE OPERATIONS, 3D BINARY PATTERNS ARE REQUIRED. THIS REQUIRES SEVERAL 2D PATTERNS WHICH WERE INDIVIDUALLY PRODUCED, AND THEN ALIGNED TO PRODUCE THE 3D EFFECT. POC PROPOSES TO DEMONSTRATE THE CONCEPT, AND TO FABRICATE 1 2D WAVEGUIDE MBOE, AND 1 3D FREE SPACE MBOE IN PHASE I. ADDITIONALLY, THEORETICAL ANALYSIS, DESIGN PROCEDURES, AND UNIQUE POTENTIAL APPLICATIONS OF THESE MBOES WILL BE INVESTIGATED. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - THE PROPOSED MULTIPLEXED BINARY OPTICAL ELEMENTS WILL OFFER UNIQUE OPPORTUNITIES FOR THE REALIZATION OF HIGH EFFICIENCY MULTIPLEXED HOLOGRAPHIC OPTICAL ELEMENTS. THUS, POTENTIAL APPLICATIONS INCLUDE MULTIPLEXED BEAM SPLITTERS/EXPANDERS/COMBINERS, MULTIPLEXED BEAM FOCUSING ELEMENTS, AND MANY OTHER MULTIPLEXED OPTICAL ELEMENTS FOR SIGNAL PROCESSING, OPTICAL STORAGE AND OPTICAL COMMUNICATIONS. KEY WORDS - BINARY OPTICS, MULTIPLEXING PROCESSING, COMPUTER GENERATED HOLOGRAMS.

ENTROPIC SPEECH, INC.  
600 PENNSYLVANIA AVE, SE, #202  
WASHINGTON, DC 20003  
Program Manager: JOHN SHORE  
Contract #:  
Title: SPEECH RECOGNITION PACKAGE  
Topic #: DARPA90-058

Office:

ID #: 50457

TECHNICAL ABSTRACT - BECAUSE SPEECH RECOGNITION R&D IS CONDUCTED IN LARGE PART THROUGH THE CREATION AND MODIFICATION OF COMPUTER SOFTWARE, PRODUCTIVITY DEPENDS HEAVILY OF SOFTWARE ENGINEERING ISSUES - THE EASE OF WRITING NEW SOFTWARE AND REUSING EXISTING SOFTWARE. THESE ISSUES ARE RELEVANT NOT JUST TO THE WORK WITHIN A PARTICULAR R&D GROUP, BUT ALSO TO THE EXCHANGE OF TECHNOLOGY AMONG DIFFERENT GROUPS. IN PARTICULAR, TECHNOLOGY TRANSFER AMONG SPEECH RECOGNITION GROUPS IS INHIBITED BY THE LACK OF CONVENIENT AND POWERFUL MEANS FOR EXCHANGING PROGRAMS AND DATA. TO ADDRESS THIS PROBLEM, A NEW SPEECH RECOGNITION PACKAGE (SRP) WILL BE DEVELOPED USING ADVANCED SOFTWARE ENGINEERING TECHNIQUES, INCLUDING ABSTRACT INTERFACES, OBJECT-ORIENTED PROGRAMMING, AND SELF-DESCRIBING OBJECTS. THESE TECHNIQUES HAVE ALREADY BEEN APPLIED TO SPEECH AND SIGNAL PROCESSING IN THE COMMERCIALY-SUCCESSFUL ENTROPIC SIGNAL PROCESSING SYSTEM (ESPS) AND WAVES+ (THE ESPS GRAPHICS INTERFACE). ESPS AND WAVES+ ARE RAPIDLY BECOMING POPULAR AT MANY OF THE WORLD'S LEADING SPEECH AND SIGNAL PROCESSING CENTERS. ESPS AND WAVES+ WILL BE USED AS A TECHNOLOGY BASE FOR THE SRP. PHASE I WILL INCLUDE A DEFINITION OF REQUIREMENTS FOLLOWED BY THE DESIGN AND IMPLEMENTATION OF PROTOTYPE MODULES. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - THE SRP WILL BENEFIT THE FEDERAL GOVERNMENT BECAUSE OF THE CONSIDERABLE SPEECH RECOGNITION R&D IT SUPPORTS. THE SRP WILL ENABLE THIS WORK TO PROCEED FASTER AND MORE EFFICIENTLY. BECAUSE THE SRP WILL BE DEVELOPED AS AN EXTENSION TO AN EXISTING COMMERCIAL PRODUCT ALREADY IN USE AT SPEECH RECOGNITION LABORATORIES, THE PROBABILITY OF COMMERCIAL SUCCESS IS HIGH. KEY WORDS - SPEECH RECOGNITION, SIGNAL PROCESSING, INFORMATION HIDING, ABSTRACT TYPES, MODULARITY, OBJECT-ORIENTED PROGRAMMING.

ARTIFICIAL INTELLIGENCE ATLANTA, INC.  
119 E. COURT SQUARE  
DECATUR, GA 30030

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**Program Manager: HENRY HEXMOOR**

**Contract #:**

**Title: DEVELOPMENT OF PLANNING SYSTEMS FOR PROBLEMS SUBJECT TO UNCERTAINTY AND RESOURCE SCARCITY**

**Topic #: DARPA90-060**

**Office:**

**ID #: 50435**

**TECHNICAL ABSTRACT - SOME INFORMATION ABOUT THE WORLD IN DYNAMIC, UNCERTAIN, RESOURCE SCARCE ENVIRONMENTS IS NOT AVAILABLE AT THE TIME OF PLANNING. KNOWLEDGE-BASED PLANNING SYSTEMS HAVE TYPICALLY ADDRESSED THIS PROBLEM BY REPLANNING AT EXECUTION TIME WHEN ADDITIONAL INFORMATION BECOMES AVAILABLE. THE OPPORTUNITY EXISTS TO COLLECT THESE TECHNIQUES IN A PLANNING SYSTEM DEVELOPMENT ENVIRONMENT THAT WOULD SUPPORT THE DESIGN OF SUCH SYSTEMS. THE OBJECTIVE OF THIS PROJECT IS THE DESIGN OF ROBUST PURPOSEFUL SYSTEMS THAT OPERATE IN UNCERTAIN, RESOURCE SCARCE, DYNAMIC ENVIRONMENTS. OUR APPROACH TO THIS PROBLEM IS MULTI-PRONGED: 1) TO SURVEY AND ANALYZE THE STRENGTHS OF EXISTING APPROACHES, 2) TO EXPLICITLY REPRESENT THE CONCEPTS OF UNCERTAINTY AND RESOURCES AND USE THESE REPRESENTATIONS IN PLANNING, 3) TO DESIGN AND PROTOTYPE A PLANNING SYSTEM DEVELOPMENT ENVIRONMENT, AND 4) USE THE DEVELOPMENT ENVIRONMENT FOR DESIGNING AND EVALUATING A PLANNING SYSTEM FOR A PROBLEM CHARACTERIZED BY UNCERTAINTY, RESOURCE SCARCITY AND TIME CRITICALITY. THE DEVELOPMENT ENVIRONMENT WILL SUPPORT MODELLING AND SIMULATION OF PROBLEM ENVIRONMENTS, THE INTEGRATION OF PLANNING/REPLANNING TECHNIQUES IN A DESIGN, AND THE ANALYSIS AND EVALUATION OF PLANNING SYSTEM DESIGNS. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - PLANNING SYSTEMS FOR REAL-TIME, UNCERTAIN, RESOURCE SCARCE ENVIRONMENTS ARE NEEDED BY THE MILITARY AND IN INDUSTRY. A DEVELOPMENT ENVIRONMENT FOR MODELING, DESIGN, ANALYSIS AND IMPLEMENTATION WOULD ENHANCE THE ENGINEERING AND DELIVERY OF SUCH SYSTEMS. KEY WORDS - KNOWLEDGE-BASED PLANNING, REPLANNING, UNCERTAINTY, RESOURCE SCARCITY, DEVELOPMENT ENVIRONMENTS.**

**SYSTEM PLANNING CORPORATION  
1500 WILSON BOULEVARD  
ARLINGTON, VA 22209**

**Program Manager: CONRAD STRACK**

**Contract #:**

**Title: KNOWLEDGE-BASED REPLANNING IN RESOURCE CONSTRAINED ENVIRONMENT**

**Topic #: DARPA90-060**

**Office:**

**ID #: 50508**

**TECHNICAL ABSTRACT - THIS SBIR EFFORT WILL DEVELOP A KNOWLEDGE-BASED PROTOTYPE LOGISTICS C3 PLANNER. THE PROPOSED STRATEGY IS TO DEFINE A SYSTEM MODEL IN WHICH AN ADAPTIVE C3 NETWORK MONITORS, GUIDES, AND MANAGES A LOGISTICS TRANSPORT NETWORK. THE BASIC TECHNIQUE IS TO BEGIN WITH A MODEL OF THE TWO INTERACTING SYSTEMS, AND THEN DEVELOP THE C3 SYSTEM'S MODEL SO THAT IT ACTUALLY PERFORMS PLANNING, AND THE MODEL BECOMES THE DESIRED SYSTEM. THE SUBSTANTIVE WORKINGS OF THE KNOWLEDGE-BASED PLANNER COMBINE SEVERAL THEMES: C3 SYSTEMS AS ADAPTIVE CONTROL NETWORKS; DYNAMIC ADJUSTMENT AMONG LOGISTICS TRAFFIC, NETWORKS, AND TRAFFIC-GENERATING PROCESSES; AND THE SPATIALLY DYNAMIC ROUTE SELECTOR AND TRAFFIC DISPATCHING LOGICS. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - OPTIMAL LOGISTICS FLOW IN THE PRESENCE OF SCARCITY (CONGESTION), UNCERTAINTY, CHANGE; END-TO-END VISIBILITY OF TRAFFIC, WITH ABILITY TO REDIRECT EN ROUTE SHIPMENTS; GUIDANCE ON WHETHER TO CONTINUE, ABANDON, MODIFY, OR REDEVELOP LOGISTICS PLANS; CONVENIENT TOOL TO PLAN FOR-OR GUARD AGAINST-TACTICAL INTERDICTION; AND CAPABILITY TO DEFINE, TEST, AND EVALUATE PROPOSED MOVEMENT REGIMES FOR SRTS. KEY WORDS - C3, AI, LOGISTICS, KNOWLEDGE-BASED, SCARCITY, UNCERTAINTY, CHANGE, NETWORKS.**



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**ADVANCED DECISION SYSTEMS**

1500 PLYMOUTH ST

MOUNTAIN VIEW, CA 94043

Program Manager: ARTHUR KELLER

Contract #:

Title: DISTRIBUTED ARTIFICIAL INTELLIGENCE/DATABASES FOR COMMAND AND CONTROL

Topic #: DARPA90-061

Office:

ID #: 50383

**TECHNICAL ABSTRACT - WE PROPOSE TO SPECIFY THE INTERFACE BETWEEN A DISTRIBUTED DECISION-MAKING LAYER AND A DISTRIBUTED STATE LAYER. THIS INTERFACE IS INTENDED TO BE PART OF A COMMAND AND CONTROL SYSTEM THAT OPERATES IN AREAS WITH LIMITED AND UNRELIABLE COMMUNICATIONS. KEY FEATURES OF THIS INTERFACE ARE THE SUPPORT FOR MULTILEVEL SECURITY, AUTONOMOUS DISTRIBUTION, AND A LACK OF ABSOLUTE CONSISTENCY. THE INTERFACE WILL BE SPECIFIED IN ADA, WITH FUNCTIONAL SPECIFICATIONS IN ANNA. THE INTERFACE WE PROPOSE TO DEVELOP WILL BE A MORE EFFECTIVE EMBEDDED DATABASE SYSTEM-PROGRAMMING LANGUAGE INTERFACE THAN SQL. IT WILL BE BASED ON RELATIONAL ALGEBRA AND INCLUDE CONDITIONALS, AGGREGATION, AND ORDERING. IT WILL ALSO INCLUDE SUPPORT FOR DATABASE VIEWS, INCLUDING UPDATING THROUGH VIEWS. THE INTERFACE WILL BE PART OF THE DADAISM (DATABASE IN AND FOR THE ADA-SUPPORTED INFORMATION SYSTEM MANAGEMENT) MODULAR DATABASE SYSTEM. THIS SYSTEM CONSISTS OF OVER 30 FORMALLY SPECIFIED MODULES COMPRISING AN OBJECT AND DATABASE SYSTEM THAT CAN EVOLVE TO INCORPORATE NEW HARDWARE AND SOFTWARE TECHNOLOGY AND CAN SUPPORT NEW REQUIREMENTS. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - THIS INTERFACE IS APPROPRIATE FOR DATABASE SYSTEM ACCESS FOR PROGRAMS IN A DISTRIBUTED ENVIRONMENT. ACCESS IS MORE EFFICIENT THAN THROUGH SQL, AS OPERATIONS CAN BE DESCRIBED IN LARGER GRANULES. THE INTERFACE IS SUITABLE FOR USE BY HIGHER LEVEL FUNCTIONS, SUCH AS KNOWLEDGE BASES AND LOGIC DATABASES. IT IS ALSO EFFECTIVE FOR INTERCONNECTION OF DISTRIBUTED SYSTEMS, INCLUDING FEDERATED AUTONOMOUS DATABASES. KEY WORDS - INTERFACES, LAYERED ARCHITECTURES, DATABASE, DISTRIBUTED SYSTEMS.**

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**UTD CORP**  
**8560 CINDERBED RD - STE 1300**  
**NEWINGTON, VA 22122**

**Program Manager: JOHN HILL III**

**Contract #:**

**Title: DEVELOPMENT OF INSPECTION AND DETECTION TECHNIQUES FOR HIDDEN CAVITIES**

**Topic #: DARPA90-062**

**Office:**

**ID #: 42524**

RECENT TREATY NEGOTIATIONS BETWEEN THE US AND THE USSR PLACE LIMITS ON THE SIZE AND LOCATIONS OF NUCLEAR TESTS. THESE LIMITS ARE PERCEIVED AS POTENTIAL INDUCEMENTS FOR THE USSR TO CONDUCT HIDDEN TESTS OUTSIDE THE TREATY REQUIREMENTS. ONE METHOD OF SECRETLY CONDUCTING TESTS WOULD BE TO PERFORM DECOUPLED TESTS IN LARGE HIDDEN UNDERGROUND CAVITIES. THE US MUST BE PREPARED TO QUICKLY AND EFFECTIVELY IDENTIFY ATTEMPTS AT TREATY VIOLATIONS. THIS PROPOSAL SPECIFIES PROCEDURES WHICH CAN BE DEVELOPED TO IDENTIFY THE EXCAVATION OR EXISTENCE OF LARGE HIDDEN UNDERGROUND CAVITIES. ADDITIONALLY, PROCEDURES WILL BE DEVELOPED FOR IDENTIFYING LIKELY CANDIDATES FOR FUTURE CAVITY EXCAVATION, TO PROVIDE A DETERRENT. THE APPROACH TAKEN BY UTD IS TO ANALYZE ALL AVAILABLE DETECTION TECHNIQUES TO DETERMINE THEIR POTENTIAL CONTRIBUTION IN DETECTING HIDDEN CAVITIES. THE GENERAL CATEGORIES OF TECHNIQUES TO BE INVESTIGATED INCLUDE: OVERHEAD IMAGERY FOR CONSTRUCTION SIGNATURE ANALYSIS; ON-SITE INSPECTION PROCEDURES UTILIZING MINING, CONSTRUCTION, AND DRILLING EXPERTISE; AND GEOPHYSICAL INVESTIGATIVE TECHNIQUES. ONCE GENERAL PROCEDURES HAVE BEEN OUTLINED, SCENARIOS WILL BE DEVELOPED, RELYING ON RELEVANT CAVITY DETECTION CASE HISTORIES AND OTHER APPLICATIONS, TO AID IN THE DETERMINATION OF DETECTION TECHNIQUE CAPABILITIES. FINALLY, PLANS FOR PHASE II VERIFICATION EXPERIMENTS AND TESTS WILL BE DEVELOPED IN THE PHASE I EFFORT. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - THIS RESEARCH WILL PROVIDE WORKING PROCEDURES AND NEW DEVELOPMENTS. KEY WORDS - CAVITY DETECTION, HIDDEN CAVITIES, MINING, DECOUPLING, ON-SITE INSPECTION, NUCLEAR TESTS, UNDERGROUND CAVITIES, DETECTION METHODS.

**BAYLESS J R CO**  
**20325 SEABOARD RD**  
**MALIBU, CA 90265**  
**Program Manager: JOHN BAYLESS**

**Contract #:**

**Title: ADVANCED LOGGING SYSTEM FOR PRECISE MEASUREMENT OF AIR-FILLED POROSITY GEOLOGICAL FORMATIONS**

**Topic #: DARPA90-063**

**Office:**

**ID #: 42492**

ACCURATE MEASUREMENTS OF AIR-FILLED POROSITY (AFP) AT DEPTHS IN THE RANGE 200-1000 M ARE REQUIRED TO PRECISELY DETERMINE THE SEISMIC MAGNITUDE OF UNDERGROUND NUCLEAR TESTS. A PROGRAM IS PROPOSED TO: (1) SPECIFY AN APPROACH, USING ONE OR MORE DIAGNOSTICS, FOR MEASURING AFP TO AN ACCURACY OF ONE POROSITY UNIT (1 PU) AND (2) TO DEVELOP A FORMATION DENSITY/LITHOLOGY LOGGING TOOL WHICH WILL FORM A KEY ELEMENT OF THE SPECIFIED MEASUREMENT APPROACH. THE PROPOSED TOOL USES A LINEAR INDUCTION ACCELERATOR (LIA) TO GENERATE A HIGH ENERGY X-RAY BEAM. IT IS SIMILAR TO EXISTING GAMMA-GAMMA LOGGING TOOLS WITH THE FOLLOWING IMPORTANT EXCEPTIONS: (1) THE X-RAY ENERGIES EXTEND UP TO ~4 MEV, THUS FACILITATING MUCH GREATER DEPTHS OF INVESTIGATION; (2) THE STAND-OFF DISTANCE OF THE X-RAY SOURCE AND THE DETECTORS FROM THE BOREHOLE WALL CAN BE SMALLER; (3) THE X-RAY SOURCE WILL HAVE A MUCH HIGHER INTENSITY WHICH HELPS TO INCREASE THE STATISTICAL ACCURACY AND (4) IT DOESN'T CONTAIN RADIOACTIVE MATERIAL, THUS SIMPLIFYING HANDLING AND TRANSPORTATION. THE OVERALL OBJECTIVE OF PHASE I IS TO DETERMINE THE FEASIBILITY OF NEW TECHNIQUES FOR MEASURING AFP TO AN ACCURACY OF 1 PU. THIS OBJECTIVE WILL BE ACCOMPLISHED BY PERFORMING THE FOLLOWING TASKS: (1) EVALUATE NEW AND EXISTING DIAGNOSTICS FOR DETERMINING AFP AND

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ESTABLISH THE REQUIREMENTS FOR AN IMPROVED APPROACH; (2) DEVELOP THE CONCEPTUAL DESIGN FOR AN EXPERIMENTAL HIGH ENERGY X-RAY TOOL WHICH WOULD BE CONSTRUCTED IN PHASE II AND (3) DEVELOP AND TEST THE KEY PORTION OF THE X-RAY TOOL IN ORDER TO DEMONSTRATE ITS FEASIBILITY. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - THIS PROJECT WILL PROVIDE AN ADVANCED LOGGING TOOL FOR MEASURING BOTH DENSITY AND LITHOLOGY IN GEOLOGICAL FORMATIONS WITH SUPERIOR DEPTHS OF INVESTIGATION. IT WILL HAVE IMPORTANT APPLICATIONS IN THE PRECISE MEASUREMENT OF AFP ABOVE AND BELOW THE WATER TABLE. IT WILL ALSO HAVE COMMERCIAL APPLICATIONS IN THE LOGGING OF OIL AND GAS WELLS.

NORTH AMERICAN GEOTECHNICAL CO  
3658 LAKE ST  
HOUSTON, TX 77098

Program Manager: E MERCADO

Contract #:

Title: A BATTLEFIELD SEISMIC NETWORK SYSTEM

Topic #: DARPA90-065

Office:

ID #: 42500

ALGORITHMS ARE DERIVED THAT DEFINE THE PATHS OF MAXIMUM COHERENCY FOR A SEISMIC EVENT GENERATED BY FIRING AN ARTILLERY WEAPON FROM AN ARBITRARY LOCATION. SIGNAL EXTRACTION TECHNIQUES ARE DESCRIBED TO EXTRACT THE COHERENT SIGNAL FROM AN EVENT RECORDED ON MULTIPLE RECEIVERS. SIMULATED BATTLEFIELD RECORDINGS ARE GENERATED BY TREATING THE SEISMIC SIGNATURE OF ARTILLERY WEAPONS AS IMPULSE RESPONSES FROM TIME-VARYING DIGITAL BAND PASS FILTERS. TECHNIQUES TO COMBINE MULTIPLE SHOTS FROM A VARIETY OF WEAPONS TYPES, PLUS ADDITION OF RANDOM NOISE ARE DESCRIBED. APPLICATION OF INVERSE FILTERS TO DISTINGUISH BETWEEN WEAPONS TYPE AS DISCUSSED. CALIBRATION TECHNIQUES TO ACCURATELY RELATE SEISMIC DERIVED BATTERY LOCATIONS TO TRUE GROUND COORDINATES ARE DESCRIBED. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - MILITARY - LOCATE ENEMY BATTERIES BY ANALYZING ACOUSTIC AND SEISMIC WAVES GENERATED BY FIRING THE WEAPON. COMMERCIAL - NONE. KEY WORDS - ACOUSTICS, INVERSE FILTER, SEISMICS, BANDPASS FILTER, NETWORK, FILTER THEORY.

EMCORE CORP  
35 ELIZABETH AVE  
SOMERSET, NJ 08873

Program Manager: DR PETER NORRIS

Contract #:

Title: DEVELOPMENT OF A SUBSTITUTE FOR (HIGH TOXIC) ARSINE GAS FOR USE IN FABRICATION OF GALLIUM ARSENIDE

Topic #: DARPA9C-066

Office:

ID #: 42471

THE USE OF ARSINE FOR THE GROWTH OF GAAS EPITAXIAL LAYERS BY METALORGANIC CHEMICAL VAPOR DEPOSITION (MOCVD) IS COMING UNDER INCREASING SCRUTINY BY GOVERNMENT AGENCIES AND COMMUNITIES. THE EXTREME TOXICITY OF ARSINE GAS, WHICH MUST BE STORED IN HIGH-PRESSURE STEEL CYLINDERS, COULD LEAD TO CATASTROPHIC CONSEQUENCES IN CASE OF AN ACCIDENTAL RELEASE OF A LARGE QUANTITY OF ARSINE. IN THE FUTURE, USE OF ARSINE MAY BE SEVERLY RESTRICTED OR PROHIBITED, AND THE SUPPLY OF GaAs-BASED MILITARY DEVICES, INCLUDING MIMICS AND OPTOELECTRONIC COMPONENTS, COULD NOT BE GUARANTEED. LOW VAPOR PRESSURE LIQUID ARSINE DERIVATIVES, WHICH AVOID THE RISKS AND HAZARDS ASSOCIATED WITH THE USE OF ARSINE, HAVE BEEN UNDER INVESTIGATION OVER THE PAST SEVERAL YEARS. THE COMPOUNDS REPORTED IN THE LITERATURE INCLUDE TRIMETHYLARSINE, TRIETHYLARSINE DIMETHYLARSINE, MONOETHYLARSINE, DIETHYLARSINE, PHENYLARSINE AND TERTIARYBUTYLARSINE (TBA). THE FIRST THREE OF THESE MATERIALS WERE FOUND TO BE RESPONSIBLE FOR UNACCEPTABLY HIGH CARBON ACCEPTOR CONCENTRATIONS CAUSED BY AN INTRINSIC PYROLYSIS MECHANISM. FOR MONOETHYL, DIETHYL AND PHENYLARSINE, IT REMAINS TO BE DEMONSTRATED THAT ECONOMIC PURIFICATION TECHNIQUES CAN BE DEVELOPED, AND THAT THEIR

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INTRINSIC CHEMISTRY IS ADEQUATE TO ACHIEVE SEMICONDUCTOR GRADE PURITY. IN THE CASE OF TBA, SYNTHESIS AND PURIFICATION TECHNOLOGY HAS BEEN DEVELOPED WHICH CONSISTENTLY YIELDS A PRODUCT OF HIGH PURITY AND EXCELLENT MATERIALS RESULTS HAVE BEEN DEMONSTRATED MAKING IT THE LEADING CANDIDATE FOR AN ASH3-FREE COMPOUND SEMICONDUCTOR TECHNOLOGY. ANTICIPATED BENEFITS/POTENTIAL COMMUNICATION APPLICATIONS - THE DEVELOPMENT OF TBA AS AN ASH3 SUBSTITUTE SHOWS GREAT PROMISE AS THE BASIS OF A COMMERCIALY VIABLE III/V EPITAXIAL TECHNOLOGY. DEVELOPMENT OF THE TBA OMVPE PROCESS AND TECHNIQUES FOR REPRODUCIBLY GROWING DEVICE-QUALITY HETEROSTRUCTURE WAFERS USING TBA HAS IMPLICATIONS FOR A BROAD RANGE OF APPLICATION AREAS INCLUDING

**SPIRE CORP**  
**PATRIOTS PK**  
**BEDFORD, MA 01730**  
**Program Manager: PATRICIA-SEKULA MOISE**  
**Contract #:**

**Title: DEVELOPMENT OF MONOETHYLARSINE AS A SUBSTITUTE FOR ARSINE IN THE MOCVD PROCESS**  
**Topic #: DARPA90-066**                      **Office:**                      **ID #: 42519**

MOCVD IS A UNIVERSALLY ACCEPTED EXPITAXIAL PROCESS FOR THE DEPOSITION OF COMPOUND SEMICONDUCTORS. IN FACT, MANY PRODUCTION FACILITIES ARE IN OPERATION. PRODUCTS INCLUDE MICROWAVE AND MILLIMETER WAVE INTEGRATED CIRCUITS (MMICS), LASER DIODES FOR COMPACT DISC PLAYERS, PHOTOCATHODES FOR NIGHT VISION GOGGLES, AND GALLIUM ARSENIDE AND INDIUM PHOSPHIDE SOLAR CELLS. THE CRITICAL WEAKNESS OF THE MOCVD TECHNIQUE IS ITS DEPENDENCE ON ARSINE GAS AS THE GROUP V REAGENT. THE EXTREME TOXICITY OF THIS SUBSTANCE NECESSITATES COSTLY DETECTION AND SAFETY EQUIPMENT. IN THE ATMOSPHERE OF INCREASING ENVIRONMENTAL AWARENESS, RESTRICTIONS ALREADY EXIST IN MANY STATES THAT FORBID OR RIGIDLY CONTROL THE AMOUNT OF ARSINE USED IN PRODUCTION. ANY MAJOR RELEASE COULD TRIGGER THE TEMPORARY OR PERMANENT SHUTDOWN OF FACILITIES THAT USE ARSINE AND, THUS, INTERRUPT THE DELIVERY OF DEVICES AND CIRCUITS FOR DEFENSE NEEDS. THE PROPOSED RESEARCH ADDRESSES THIS PROBLEM BY SEEKING TO DEVELOP MONOETHYLARSINE AS A REPLACEMENT FOR ARSINE. IT IS A HIGH VAPOR PRESSURE LIQUID SOURCE WHOSE TOXICITY IS EXPECTED TO BE MUCH LOWER THAN THAT OF ARSINE, IS NOT SYNTHESIZED FROM ARSINE, AND IS EXPECTED TO BE PRICED COMPETITIVELY WITH ARSINE ONCE IT IS IN FULL PRODUCTION. THESE AND OTHER REASONS MAKE MONOETHYLARSINE AN EXTREMELY ATTRACTIVE ALTERNATIVE TO ARSINE. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - IF THE QUALITY OF GaAs FILMS GROWN WITH MONOETHYLARSINE IS COMPARABLE TO THOSE GROWN WITH ARSINE, MONOETHYLARSINE COULD COMPLETELY REPLACE ARSINE AS A COST-COMPETITIVE GROUP V SOURCE, OVER THE NEXT FEW YEARS, FOR THE MOCVD GROWTH OF III-V SEMICONDUCTORS. SPIRE CORPORATION WILL COMMERCIALIZE THIS TECHNOLOGY BY SELLING CUSTOM WAFERS GROWN WITH MONOETHYLARSINE, VIA ITS EXPITAXIAL PRODUCTS SERVICE GROUP. KEY WORDS - MONOETHYLARSINE, TOXICITY, ETHYLARSINE, ARSINE, MOCVD

**FOSTER-MILLER INC**  
**350 SECOND AVE**  
**WALTHAM, MA 02154**  
**Program Manager: K JAYARAJ**  
**Contract #:**

**Title: ULTRAHIGH DENSITY LOW-COST MULTICHIP PACKAGING**  
**Topic #: DARPA90-068**                      **Office:**                      **ID #: 42481**

FOSTER-MILLER PROPOSES TO DEVELOP AN INNOVATIVE MULTICHIP PACKAGING (MCP) APPROACH THAT WILL RESULT IN SIGNIFICANT IMPROVEMENT IN SILICON PACKING DENSITY AND REDUCTION IN COST COMPARED TO STATE-OF-THE-ART MCP TECHNOLOGIES. THE FOSTER-MILLER APPROACH WILL USE HIGHLY IMPERMEABLE LIQUID CRYSTAL POLYMERS TO ELIMINATE THE NEED FOR A "HERMETIC HOUSING" FOR

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DARPA Solicitation 90.2

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MULTICHIP PACKAGES. A NOVEL PROCESS IS PROPOSED TO SEPARATE THE THERMAL AND ELECTRICAL PATH IN THE MULTICHIP PACKAGE, AND TO ELIMINATE PROCESSING STRESSES IN THE MULTILAYER INTERCONNECT. FOSTER-MILLER'S APPROACH WILL ELIMINATE THE MOST SEVERE LIMITATIONS OF THE CURRENT CONVENTIONAL THIN FILM MCP APPROACHES AND THE GE OVERLAY APPROACH. IN PHASE I FOSTER-MILLER WILL IDENTIFY A COMPATIBLE PROCESS SEQUENCE TO IMPLEMENT THE PROPOSED APPROACH AND DEMONSTRATE KEY COMPONENTS OF THE APPROACH. BENEFITS OF THIS APPROACH WILL BE DEMONSTRATED BY PERFORMING A QUANTITATIVE PERFORMANCE/COST COMPARISON WITH OTHER MCP TECHNOLOGIES. IN PHASE II, WE WILL TEAM WITH MARTIN-MARIETTA TO DETERMINE PERFORMANCE CHARACTERISTICS OF OUR APPROACH, AND IMPLEMENT IT IN A MILITARY SYSTEM. FABRICATION OF A HIGHER PERFORMANCE, AND LOWER COST SUBSYSTEM WILL ESTABLISH A FIRM BASIS FOR A COMMERCIAL SUPPORTED PHASE III PROGRAM. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - THE FOSTER-MILLER APPROACH WILL INCREASE THE SILICON PACKAGING DENSITY BY A FACTOR OF TWO, AND DECREASE THE COST, WEIGHT, VOLUME, AND THE THERMAL IMPEDANCE BY AT LEAST A FACTOR OF TWO COMPARED TO THE MOST ADVANCED MCP APPROACHES AVAILABLE. DARPA AND DOD WILL HAVE A POWERFUL MCP TECHNOLOGY TO PACKAGE AIRBORNE AND SPACE BORNE PERFORMANCE. THE COMBINATION OF HIGH PERFORMANCE AND LOW COST WILL GENERATE WIDE-SPREAD COMMERCIAL APPLICATIONS OF THIS TECHNOLOGY TO

CASCADE MICROTECH INC  
14255 SW BRIGADOON CT  
BEAVERTON, OR 97005

Program Manager: KEITH JONES

Contract #:

Title: 110 GHZ ON-WAFER MEASUREMENTS AND ELEMENT MODELING

Topic #: DARPA90-070

Office:

ID #: 42460

ON-WAFER MICROWAVE PROBE MEASUREMENTS HAVE DEMONSTRATED THEIR UNIQUE PERFORMANCE AND PRODUCTIVITY GAINS IN SEMICONDUCTOR RESEARCH, DEVELOPMENT AND PRODUCTION ACTIVITIES. HOWEVER, DEVICE PERFORMANCE CONTINUES TO OUTPACE OUR ABILITY TO MEASURE AT THE WAFER LEVEL. AS PROBE PERFORMANCE CONTINUES INTO MILLIMETER WAVELENGTHS, THE MEASUREMENT CHALLENGE INCREASES. FORMERLY NEGLIGIBLE PROBE CONNECTION PARASITICS GROW IN MAGNITUDE WHILE THE DUT GEOMETRY AND PARASITICS TYPICALLY SHRINK. THIS PROPOSAL ADDRESSES ON-WAFER MILLIMETER-WAVE MEASUREMENT ISSUES TO 110 GHZ IN THE AREAS OF CALIBRATION STANDARD ELEMENTS AND METHODS, FET PATTERNS, S-PARAMETER MEASUREMENT TECHNIQUES AND NOISE PARAMETER MEASUREMENTS. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - AVAILABILITY OF ON-WAFER SEMICONDUCTOR MEASUREMENT CAPABILITY TO 110 GHZ. KEY WORDS - WAFER, MILLIMETER, PROBE, FET, NOISE, CALIBRATION, S-PARAMETERS, MEASUREMENT.

APPLIED PULSED POWER  
265 IRISH SETTLEMENT RD  
FREEVILLE, NY 13068

Program Manager: STEVEN GLIDDEN

Contract #:

Title: HIGH THROUGHPUT X-PINCH SOFT X-RAY SOURCE FOR X-RAY LITHOGRAPHY

Topic #: DARPA90-072

Office:

ID #: 42453

X-RAY LITHOGRAPHY WILL BE USED IN THE FUTURE TO MAKE SEMICONDUCTOR DEVICES HAVING FEATURE SIZES OF  $< .25$  MICROMETERS. THE X-PINCH SOFT X-RAY SOURCE BEING DEVELOPED AT THE LABORATORY OF PLASMA STUDIES, CORNELL UNIVERSITY, APPEARS TO BE AN ATTRACTIVE SOURCE FOR LITHOGRAPHY FROM BOTH A CAPITAL COST AND THROUGHPUT STANDPOINT. CURRENT EXPERIMENTAL RESULTS INDICATE THAT A PROTOTYPE X-PINCH SOURCE DRIVEN BY A 550KA 80NS FWHM PULSED POWER GENERATOR IS CAPABLE OF RESIST EXPOSURE TIMES OF  $< 3$  SECONDS OPERATING AT 1-10 PULSES PER

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SECOND AND CAN BE FABRICATED FOR UNDER \$500,000. THE OBJECTIVE OF THIS PHASE I PROPOSAL EFFORT IS TO DESIGN A HIGH THROUGHPUT PROTOTYPE X-RAY SOURCE BASED ON CURRENT AND FUTURE RESULTS FROM THE X-PINCH EXPERIMENTS AT CORNELL UNIVERSITY. THE X-PINCH DRIVER POWER AND REPETITION RATE REQUIREMENTS WILL BE DETERMINED BY EXAMINING RESIST SENSITIVITIES AND MASK TO WAFER ALIGNMENT TOLERANCES. A DEVICE FOR REPLACING THE X-PINCH WIRE ARRAY UP TO TEN TIMES PER SECOND WILL BE DESIGNED. A PROTOTYPE REPETITION RATE PULSED POWER GENERATOR WILL BE DESIGNED. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - SUCCESSFUL DEVELOPMENT OF THE X-PINCH SOURCE WOULD RESULT IN A COMPACT, INEXPENSIVE X-RAY SOURCE FOR LITHOGRAPHY. THIS WOULD PERMIT DEVELOPMENT OF A  $< .25$  MICROMETER FEATURE SIZE SEMICONDUCTOR MANUFACTURING FACILITY ON A SMALL SCALE WITH LOW INITIAL CAPITAL COSTS (IN COMPARISON WITH SYNCHROTRON SOURCES) WHICH COULD THEN BE INCREASED IN SIZE INCREMENTALLY AS TECHNOLOGIES AND MARKET DEMANDS DICTATE. KEY WORDS - LITHOGRAPHY, SEMICONDUCTOR TECHNOLOGY, X-RAY, X-PINCH, PULSED POWER.

JAMAR TECHNOLOGY CO  
3956 SORRENTO VALLEY BLVD - STE D  
SAN DIEGO, CA 92121  
Program Manager: DR HARRY SHIELDS  
Contract #:  
Title: A STUDY OF EXCIMER LASER-BASED X-RAY SOURCE TECHNOLOGY ISSUES  
Topic #: DARPA90-072                      Office:                      ID #: 42490

ADVANCED SEMICONDUCTOR MEMORY DEVICES AND HIGH SPEED PROCESSORS WILL REQUIRE EXTREMELY FINE PATTERNS TO BE LITHOGRAPHICALLY REPRODUCED ON SILICON WAFERS. X-RAY LITHOGRAPHY IS CURRENTLY FAVORED TO MEET FUTURE INDUSTRY NEEDS. RECENT DEVELOPMENTS, USING ELECTRON STORAGE RING (SYNCHROTRON) RADIATION, HAVE DEMONSTRATED GREAT POTENTIAL, BUT LACK OF A COMPACT, AFFORDABLE X-RAY SOURCE WITH SUFFICIENT INTENSITY TO MEET PRODUCTION WAFER THROUGHPUT REQUIREMENTS IS HINDERING FURTHER PROGRESS TO COMMERCIAL IMPLEMENTATION. JAMAR TECHNOLOGY CO. IS CURRENTLY DEVELOPING A HIGH BRIGHTNESS, POINT X-RAY SOURCE GENERATED BY AN EXCIMER LASER PRODUCED PLASMA. THE PRIVATELY FUNDED PROGRAM USES THE COMPANY'S PROPRIETARY XECL LASER TECHNOLOGY. IT IS PROPOSED TO EVALUATE SEVERAL TECHNIQUES WHICH MIGHT LEAD TO INCREASED INTENSITY FROM THIS LASER-PLASMA SOURCE. PHASE I INCLUDES AN EXPERIMENTAL VERIFICATION OF BASELINE SOURCE POWER, A STUDY OF POWER ENHANCEMENT TECHNIQUES, A PRELIMINARY DESIGN OF AN UPGRADED SYSTEM AND ANALYSES OF SYSTEM PERFORMANCE, WAFER THROUGHPUT, COST FACTORS, PROCESS ISSUES, ETC. PHASE II WILL RESULT IN AN UPGRADED LABORATORY X-RAY LITHOGRAPHY SYSTEM FOR EVALUATION BY SEMICONDUCTOR EQUIPMENT AND DEVICE MANUFACTURERS. PHASE III WILL BUILD A MANUFACTURING PROTOTYPE USING FUNDS FROM JOINT VENTURES WITH INDUSTRY PARTNERS AND FURTHER FEDERAL SUPPORT AS AVAILABLE. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - ADVANCED SEMICONDUCTOR LITHOGRAPHY APPLICATIONS INCLUDE DEVICES SUCH AS 64 MBIT DYNAMIC RANDOM ACCESS MEMORIES (DRAM'S), APPLICATION SPECIFIC INTEGRATED CIRCUITS (ASIC'S) AND GaAs DEVICES. THE MAJOR BENEFIT IS THE AVAILABILITY OF A POWERFUL, AFFORDABLE, GRANULAR X-RAY SOURCE. KEY WORDS - X-RAY LITHOGRAPHY, LASER-PRODUCED PLASMAS, EXCIMER

MEDOX ELECTRO-OPTICS INC  
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ANN ARBOR, MI 48105  
Program Manager: PHILIPPE BADO  
Contract #:  
Title: HIGH BRIGHTNESS X-RAY SOURCES FOR X-RAY LITHOGRAPHY  
Topic #: DARPA90-072                      Office:                      ID #: 42496

LASER DRIVEN PLASMA SOURCES ARE POTENTIAL X-RAY SOURCES FOR MICROLITHOGRAPHIC

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APPLICATIONS. UNFORTUNATELY, TO DATE, THESE PLASMA SOURCES HAVE NOT PRODUCED THE X-RAY INTENSITIES REQUIRED FOR LARGE SCALE MANUFACTURING. CHIRPED PULSE AMPLIFICATION, AN INNOVATIVE LASER ARCHITECTURE CONCEPT, COMPATIBLE WITH MOST SOLID STATE SOURCES, IS CAPABLE OF INCREASING THE PEAK POWER OF SMALL LASER SYSTEMS ONE THOUSAND FOLD. THIS PHASE I PROGRAM WILL QUANTITATIVELY EVALUATE THE ONE TO THREE ORDERS OF MAGNITUDE CAPABILITY ENHANCEMENT ANTICIPATED FROM THE INTRODUCTION OF CHIRPED PULSE AMPLIFICATION IN THE DESIGN OF X-RAY LITHOGRAPHIC SOURCES. IN PARTICULAR, WE WILL ANALYZE: 1. THE UPGRADING OF EXISTING LASER-DRIVEN PLASMA SOURCES AND, 2. THE SYNERGISM RESULTING FROM THE COMBINED USE OF ADVANCED SOLID-STATE GAIN MEDIA WITH CHIRPED PULSE AMPLIFICATION. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - THROUGH THE USE OF CHIRPED PULSE AMPLIFICATION (CPA), WE WILL SIGNIFICANTLY ENHANCE THE X-RAY INTENSITIES PRODUCED BY LASER-DRIVEN PLASMA SOURCES. CPA BASED SOLID-STATE LASERS CAN MEET THE INDUSTRY THROUGHPUT REQUIREMENT AND ARE A COMPACT ALTERNATIVE TO SYNCHROTRON-BASED SOURCES. KEY WORDS - X-RAY SOURCE, X-RAY LITHOGRAPHY, SOLID-STATE LASER, CHIRPED PULSE AMPLIFICATION.

ATLANTIC AEROSPACE ELECTRONICS CORP

6404 IVY LN - STE 300

GREENBELT, MD 20770

Program Manager: DAVID COOMBER

Contract #:

Title: DEEP UV PHOTO RESIST DEVELOPMENT

Topic #: DARPA90-073

Office:

ID #: 42456

WE PROPOSE TO IMPROVE RESIST MATERIAL DEVELOPMENT BY USING COMPUTATIONAL SIMULATION TO EVALUATE THE MATERIAL PROPERTIES SUITABLE FOR THE DEEP UV RANGE. WE PROPOSE TO DISCUSS CURRENT MATERIALS WITH RESIST PRODUCERS AND THEN TO WORK WITH THE MANUFACTURERS OF PHOTOLITHOGRAPHY SYSTEMS AND THE DESIGNERS OF SEMICONDUCTORS TO DEVELOP PROCEDURES AND DESIGN RULES WHICH ARE CONSISTENT WITH THE OPTIMAL USE OF THE RESIST MATERIAL AND ITS SOLVENT. CURRENT COMPUTATIONAL SIMULATIONS WILL NOT BE ADEQUATE FOR RESIST DEVELOPMENT IN THE DEEP UV BECAUSE MUCH NEW MATERIAL PHYSICS NEEDS TO BE INCLUDED, IE, RESIST MATERIALS UNDER CURRENT CONSIDERATION HAVE LOW TRANSPARENCY AND HIGH ABSORPTION RATIOS IN THE DEEP UV RANGE. NOT ONLY DO NEW RESIST MATERIALS NEED TO BE DEVELOPED BUT WHOLE NEW PROPERTIES NOT FOUND IN CURRENT RESISTS ARE ALSO DESIRABLE, FOR INSTANCE, DUAL-TONE RESISTS AND CHEMICALLY AMPLIFIED RESISTS. WE CURRENTLY HAVE THE BEST MODEL OF THREE-DIMENSIONAL PHOTORESIST IMAGES AVAILABLE. THIS NUMERICAL SIMULATION CAN BE USED TO IMPROVE THE DESIGN PROCESS FOR RESISTS, SOLVENTS AND PROCESSES BY REDUCING THE CUT AND TRY WHICH WILL BE REQUIRED FOR THE WIDE RANGE OF NEW PROPERTIES DESIRED IN THE DEEP UV RANGE. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - MILITARY WEAPON SYSTEMS HAVE BECOME INCREASINGLY DEPENDENT ON MICROELECTRONICS TO CREATE MORE FUNCTION IN SMALLER SPACES WITH LESS POWER. METHODS - SUCH AS THIS NUMERICAL SIMULATION OF THE RESIST DESIGN PROCESS FOR THE DEEP UV - WHICH CONTINUE RAPID EVOLUTION OF VLSI TECHNOLOGY AND WHICH BRING SUB-MICRON SYSTEMS TO REALITY ON SHORTER SCHEDULES WILL CONTINUE THE RAPID IMPROVEMENT IN PERFORMANCE OF MILITARY SYSTEMS. KEY WORDS - VLSI DESIGN, PHOTORESIST, NUMERICAL SIMULATION, DEEP ULTRAVIOLET

GELTECH INC

BOX 18 - ONE PROGRESSIVE BLVD

ALACHUA, FL 32615

Program Manager: DR JEAN-LUC NOGUES

Contract #:

Title: FABRICATION OF MICRO-OPTICAL COMPONENTS BY SOL-GEL TECHNOLOGY

Topic #: DARPA90-074

Office:

ID #: 42482

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DARPA Solicitation 90.2

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THE SOL-GEL PROCESS ALLOWS FOR THE PREPARATION OF POROUS, SILICA OPTICAL COMPONENTS, TERMED TYPE VI SILICA. A NOVEL POTENTIAL APPLICATION FOR TYPE VI SILICA IS PROPOSED IN WHICH THE POROUS MATRIX IS USED AS A SUBSTRATE FOR THE FABRICATION OF MICRO-OPTICAL COMPONENTS. THE POROUS NATURE OF THE MATERIAL ALLOWS LASER-ENHANCED DENSIFICATION FOR THE PRODUCTION OF PLANAR OPTICAL WAVEGUIDES AND MICRO-OPTICAL ARRAYS. INVESTIGATIONS ARE PROPOSED FOR THE CHARACTERIZATION OF THE TYPE VI SILICA WITH REGARD TO ITS MECHANICAL AND THERMAL STABILITY, ULTRASTRUCTURE, AND OPTICAL PROPERTIES AS A FUNCTION OF TEMPERATURE OF DENSIFICATION. LASER-ENHANCED DENSIFICATION EXPERIMENTS ARE PROPOSED FOR THE FABRICATION OF SELECTED MICRO-OPTICAL COMPONENTS. ALTERNATIVE MANUFACTURING TECHNIQUES OF MICRO-OPTICAL COMPONENTS WILL BE INVESTIGATED AND COMPARED WITH RESPECT TO COST, EASE OF MANUFACTURE AND PERFORMANCE ADVANTAGE. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - CONSIDERING THE EXPENSE, THE DIFFICULTY AND EVEN THE IMPOSSIBILITY OF MANUFACTURING MICRO-OPTICS, THIS RESEARCH PROGRAM REPRESENTS A REAL OPPORTUNITY FOR THE DEVELOPMENT OF A NEW TECHNOLOGY FOR THE FABRICATION OF MICRO-OPTICAL COMPONENTS - WHICH ARE THE FUTURE OF THE OPTIC AND OPTOELECTRONIC INDUSTRIES. KEY WORDS - MICRO-OPTICS, SOL-GEL, LASER, DENSIFICATION, WAVEGUIDE, LENS ARRAYS, GRIN

APA OPTIC INC  
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Program Manager: DR M ASIF KHAN

Contract #:

Title: A SOLID STATE BLUE LASER BASED ON GAN/AlXGa1-XN PN JUNCTION HETEROSTRUCTURE

Topic #: DARPA90-076

Office:

ID #: 42452

IN THIS PROPOSAL WE DISCUSS THE DEVELOPMENT OF A BLUE (POTENTIALLY GREEN AND OTHER WAVELENGTHS ALSO) SOLID STATE LASER BASED ON PN-JUNCTION HETEROSTRUCTURES IN THE AlXGa1-XN MATERIAL SYSTEM. THESE AlXGa1-XN BASED LASERS WILL BE IDEAL FOR USES IN OPTICAL RECORDING, COMMUNICATION AND LARGE SCREEN DISPLAY SYSTEMS. ESSENTIALLY ALL APPLICATIONS CURRENTLY BEING ADDRESSED BY ARGON-ION LASERS WILL BE IMPACTED. WE (AND OTHER GROUPS) HAVE DEPOSITED HIGH OPTICAL QUALITY (PHOTOLUMINESCENCE) N-TYPE SINGLE CRYSTALS AND QUANTUM WELLS OF AlXGa1-XN USING ATOMIC LAYER MOCVD. STIMULATED EMISSION HAS ALSO BEEN DEMONSTRATED BY PHOTOPUMPING N-TYPE MATERIAL CAVITIES. SEVERAL P-TYPE DOPANTS CAN BE INCORPORATED IN AlXGa1-XN (BANDGAP 3.6 TO 6.2 EV) WITH ZINC GIVING A STRONG RADIATIVE TRANSITION AT 470-480 NM. USING THIS WE HAVE DEMONSTRATED BLUE MIS EMITTERS. ONLY RECENTLY USING MOCVD P-TYPE GAN HAS FOR THE FIRST TIME BEEN DEPOSITED. MUCH EFFORT IS STILL NEEDED TO IMPROVE THE DOPING LEVELS, PHOTOLUMINESCENCE OF P-DOPED MATERIAL, AND THE P-DOPING OF THE ALLOY. THIS WILL BE THE PRIME FOCUS OF OUR PHASE I PROGRAM. LASER ASSISTED ALE WILL BE USED TO DEPOSIT AND CHARACTERIZE AlXGa1-XN PN-JUNCTIONS. THESE FORM THE BASIS OF AN AlXGa1-XN BASED BLUE LASER TO BE FABRICATED AND CHARACTERIZED IN PHASE II. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - THE LASERS WE PLAN TO DEVELOP WILL BE IDEAL FOR ANY APPLICATION CURRENTLY ADDRESSED USING ARGON ION OR OTHER GAS LASERS. THEY WILL INCREASE OPTICAL RECORDING DENSITY BY A FACTOR OF FIVE. WE FEEL THEY WILL ALSO IMPACT THE BLUE-GREEN COMMUNICATION AREA. KEY WORDS - AlXGa1-XN, PN-JUNCTIONS, ATOMIC LAYER MOCVD, MICROLASERS.

SCHWARTZ ELECTRO-OPTICS INC  
45 WINTHROP ST  
CONCORD, MA 01742

Program Manager: DR JAMES HARRISON

Contract #:

Title: DEVELOPMENT OF A HIGH-POWER CW DIODE-PUMPED BLUE LASER

Topic #: DARPA90-076

Office:

ID #: 42516



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WE PROPOSE TO INVESTIGATE THE USE OF A CW, FREQUENCY DOUBLED, DIODE-PUMPED SOLID STATE LASER IN THE GENERATION OF WATT-LEVEL BLUE LIGHT, FOR APPLICATIONS TO LARGE-SCREEN PROJECTION DISPLAYS. THE SPECIFIC SYSTEM TO BE STUDIED WOULD BE A 946-NM ND:YAG LASER EMPLOYING AN INTRACAVITY DOUBLING CRYSTAL OF POTASSIUM NIOBATE (KNBO3). SINGLE-FREQUENCY, RING-LASER OPERATION WOULD PERMIT EFFICIENT EXTRACTION OF THE SECOND-HARMONIC OUTPUT AND ALSO MINIMIZE POTENTIAL AMPLITUDE NOISE DUE TO LONGITUDINAL MODE-BEATING. THE TASKS INVOLVED WOULD BE THE DESIGN AND CONSTRUCTION OF A CW ND:YAG GAIN MODULE, PUMPED BY A 10-W DIODE LASER BAR, THE CONSTRUCTION AND EVALUATION OF A UNIDIRECTIONAL RING LASER, THE EXPERIMENTAL EVALUATION OF HARMONIC GENERATION IN TYPE I, NONCRITICALLY PHASE-MATCHED KNBO3, AND THE DEVELOPMENT OF A POINT DESIGN FOR A 3-W, CW BLUE LASER OPERATING AT 473 NM. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - APPLICATIONS IN LARGE-SCREEN PROJECTION, PRINTING, REPROGRAPHICS, CELL COUNTING, MICROSCOPY FLUORESCENCE AND RAMAN ANALYSIS, SCIENTIFIC INSTRUMENTATION, OPTICAL MEMORIES AND CLINICAL MEDICINE ARE AMONG THE MOST OBVIOUS FOR THE PROPOSED LASER. THE COMMERCIAL MARKET SIZE FOR MULTI-WATT, VISIBLE SOLID STATE LASERS COULD WELL DEVELOP INTO THE \$100 MILLION RANGE. KEY WORDS - SOLID STATE LASER, HARMONIC GENERATION, DIODE PUMPING

FOSTER-MILLER INC  
350 SECOND AVE  
WALTHAM, MA 02154  
Program Manager: DR MARK DRUY  
Contract #:  
Title: NOVEL IN SITU FIBER OPTIC FTIR PROCESS MONITOR FOR MOCVD  
Topic #: DARPA90-077                      Office:                      ID #: 42480

FOSTER-MILLER PROPOSES TO DEVELOP A NOVEL IN SITU PROCESS MONITOR TO COMPLETELY CHARACTERIZE AND CONTROL THE MOCVD GROWTH PROCESS FOR MERCURY CADMIUM TELLURIDE (MCT). IT WILL BE BASED ON FOSTER-MILLER'S HIGHLY SUCCESSFUL REMOTE FIBER OPTIC FTIR PROCESS MONITOR. THIS TOOL WAS DEVELOPED BY FOSTER-MILLER TO MONITOR AND CONTROL POLYMER REACTIONS IN HOSTILE ENVIRONMENTS, AND IS A WINNER OF A RECENT IR-LOO AWARD. IN PHASE I, FOSTER-MILLER WILL TEAM WITH SPIRE CORPORATION AND LORAL INFRARED AND IMAGING SYSTEMS TO DEMONSTRATE KEY ELEMENTS OF OUR CONCEPT. WE WILL DEMONSTRATE THAT THE FIBER OPTIC FTIR SYSTEM CAN MEASURE THE EPILAYER THICKNESS AND COMPOSITION, AS WELL AS GAS PHASE COMPOSITIONS AND GAS PHASE REACTIONS. WE WILL ALSO RESOLVE KEY ISSUES OF PRACTICAL IMPLEMENTATION SO THAT THE SYSTEM WILL BE READY FOR IMMEDIATE INTEGRATION INTO AN MOCVD REACTOR. IN COOPERATION WITH SPIRE CORPORATION, WE WILL INTEGRATE THE MONITOR INTO AN MOCVD SYSTEM IN PHASE II. REPRODUCIBLE GROWTH OF MCT EPILAYERS WITH IMPROVED UNIFORMITY IN PHASE II, WILL FORM A FIRM BASIS FOR A COMMERCIALY SUPPORTED PHASE III PROGRAM. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - THE PRECISE CHARACTERIZATION AND CONTROL OF THE MOCVD PROCESS, AFFORDED BY THIS MONITOR, WILL SIGNIFICANTLY IMPROVE THE YIELD AND REPRODUCIBILITY OF THE MCT EPILAYERS. THIS WILL RESULT IN SIGNIFICANT REDUCTION IN FOCAL PLANE ARRAY AND IR DETECTOR SYSTEM COSTS TO DOD. DARPA AND DOD WILL HAVE A POWERFUL IN SITU PROCESS MONITOR THAT CAN SIGNIFICANTLY ENHANCE THE REPRODUCIBILITY AND YIELD OF MANY SEMICONDUCTOR FABRICATION PROCESSES, INCLUDING THE MOCVD III-V COMPOUNDS. KEY WORDS - FIBER OPTIC REMOTE SPECTROSCOPY, MERCURY CADMIUM TELLURIDE, MOCVD, IN SITU PROCESS MONITOR, IR ABSORPTION SPECTROSCOPY, FOCAL PLANE ARRAYS.

TTL TECHNIQUES  
65 LIMEKILN PIKE  
GLENSIDE, PA 19038  
Program Manager: DR KIM  
Contract #:  
Title: COMBINATION HADAMARD TRANSFORM AND RAMAN SPECTROSCOPY WITH SPECTROSCOPIC

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ELLIPSOmetry FOR IN SITU ...

Topic #: DARPA90-077

Office:

ID #: 42522

TTL TECHNIQUES HAS INTRODUCED HADAMARD/RAMAN SPECTROSCOPY (HRS) AS A DIAGNOSTIC TOOL TO MONITOR THE DEPOSITION ENVIRONMENT IN LOW TEMPERATURE PLASMA ASSISTED METAL ORGANIC CHEMICAL VAPOR DEPOSITION (PAMOCVD) OF MERCURY CADMIUM TELLURIDE (HGCDTE). HRS CONFIGURED TOGETHER WITH OPTICAL EMISSION SPECTROSCOPY (OES), ATOMIC ABSORPTION SPECTROSCOPY (AAS), GLOW DISCHARGE MASS SPECTROSCOPY (GDMS), AND SPECTROSCOPIC ELLIPSOmetry (SE). THE ELECTRIC FIELDS, GAS SPECIES TEMPERATURES AND VELOCITIES AND CONCENTRATIONS WILL BE STUDIED AND THEIR RELATION WITH GAS PHASE CHEMISTRY, SURFACE CHEMISTRY AS MODIFIED BY ENERGETIC PARTICLE OR PHOTON BOMBARDMENT, FILM STOICHIOMETRY, AND BONDING STRUCTURE, PROPERTIES, AND THE PLASMA/MATERIAL SURFACE PROPERTIES AND DEPOSITION CHARACTERISTICS OF HGCDTE PAMOCVD WILL BE STUDIED. THE OBSERVATIONS MADE BY THE HADAMARD/RAMAN SPECTROMETER MONITORING TECHNIQUE ARE OBTAINED BY MEASURING THE INTENSITY OF LIGHT TRANSMITTED THROUGH THE REACTOR AS WELL AS THE LIGHT SCATTERING EFFECTS OF VARIOUS GASES. IF THE ABSORPTION, EMISSION, AND SCATTERING SPECTRUM OF THE OUTPUT CORRELATES WITH KNOWN GASES, THE CONCENTRATION OF EACH INDIVIDUAL REACTANT GAS CAN BE DETERMINED. THE DEVICE CAN BE BUILT INEXPENSIVELY, IS HIGHLY ACCURATE, AND CAN MEASURE VERY LOW GAS CONCENTRATIONS AT MULTIPLE CHAMBER LOCATIONS SIMULTANEOUSLY WITH A SINGLE INSTRUMENT. THE RELATIONSHIP BETWEEN THE RESULTS OF HRS AND TEMPERATURE, GAS FLOW RATES, CONCENTRATION OF INLET GASES WILL BE ESTABLISHED AND USED TO DEVELOP FEEDBACK CONTROL PARAMETERS BY A COMPUTER. THE OPTICAL PROPERTIES AND DIELECTRIC FUNCTION OF THE HGCDTE THIN FILM WILL BE MEASURED IN REAL TIME BY SE AND WILL BE RELATED WITH OPERATIONAL CONDITIONS OF THE MOCVD. LOW TEMPERATURE PLASMA ENHANCED MOCVD (PEMOCVD) WILL BE STUDIED IMPLEMENTING A UNIQUE CONFIGURATION OF IN-SITU OPTICAL EMISSION (OE) ATOMIC ABSORPTION (AA) SPECTROSCOPY AND GLOW DISCHARGE MASS SPECTROSCOPY (GDMS). ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - DEVELOPMENT

FORE SYSTEMS INC

116 GREYFRIAR DR

PITTSBURGH, PA 15215

Program Manager: DR ONAT MENZILCIOGLU

Contract #:

Title: DEVELOPMENT OF A GIGABIT ATM LOCAL-AREA NETWORK

Topic #: DARPA90-080

Office:

ID #: 42476

FORE SYSTEMS PROPOSES TO DEVELOP A GIGABIT-SPEED LOCAL-AREA NETWORK BASED ON THE ATM (ASYNCHRONOUS TRANSFER MODE) STANDARD. ATM IS A NEW TELECOMMUNICATIONS STANDARD THAT IS THE BASIS FOR THE FORTHCOMING WORLDWIDE BROADBAND INTEGRATED SERVICES DIGITAL NETWORK (B-ISDN). THE ATM STANDARD IS ALSO ATTRACTIVE FOR LOCAL-AREA NETWORKS BECAUSE IT IS DESIGNED TO SUPPORT HIGH-SPEED MULTI-MEDIA COMMUNICATION (SIMULTANEOUS DATA, AUDIO, AND VIDEO COMMUNICATION) OVER THE SAME NETWORK. FORE SYSTEMS' PROPOSED NETWORK ARCHITECTURE WILL USE HIGH-SPEED (622 MBITS/SEC) FIBER-OPTIC LINKS CONNECTED TO FAST PACKET SWITCHES THAT CAN HANDLE THE SMALL PACKETS, OR CELLS, SPECIFIED BY THE ATM STANDARD. IN ORDER TO CONNECT COMPUTERS TO THE NETWORK, FORE SYSTEMS PROPOSES TO DEVELOP 622 MBITS/SEC ATM INTERFACES FOR HIGH-END WORKSTATIONS. BOTH THE COMPUTER AND SWITCH INTERFACES WILL BE BUILT AROUND A SINGLE ASIC CHIP THAT WILL HANDLE ATM CELL PROCESSING, LEADING TO A HIGHLY-INTEGRATED, COST-EFFECTIVE IMPLEMENTATION. DURING THE PHASE I, FORE SYSTEMS WILL STUDY THE HARDWARE AND SOFTWARE REQUIREMENTS OF THE PROPOSED ARCHITECTURE AND ESTABLISH ITS FEASIBILITY. IN PARTICULAR, THE RESULTS OF THE PHASE I STUDY WILL INCLUDE HIGH-LEVEL DESIGNS AND COST ESTIMATES OF THE HARDWARE COMPONENTS, SPECIFICATION OF SYSTEMS SOFTWARE, AND PERFORMANCE ANALYSIS. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - THE SUCCESSFUL COMPLETION OF THIS RESEARCH WILL PROVIDE THE BASIS FOR THE COMMERCIAL DEVELOPMENT OF A GIGABIT/SECOND ATM-BASED LOCAL-AREA NETWORK. KEY WORDS -

SMALL BUSINESS INNOVATION RESEARCH PROGRAM - PHASE I  
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LOCAL-AREA NETWORKS, ASYNCHRONOUS TRANSFER MODE, NETWORK INTERFACES

OPTIVISION INC  
744 SAN ANTONIO RD - STE 10  
PALO ALTO, CA 94303  
Program Manager: ANTONIO DIAS  
Contract #:

Title: INEXPENSIVE GIGABIT LAN

Topic #: DARPA90-080

Office:

ID #: 42502

THIS IS A PROPOSAL FOR AN INEXPENSIVE GIGABIT LOCAL AREA NETWORK (LAN) WHICH AUGMENTS STANDARD LOW SPEED LOCAL AREA NETWORKS SUCH AS ETHERNET OR FDDI FOR GREATLY IMPROVED PERFORMANCE OVER DISTANCES ON THE ORDER OF 1 KM. THE GIGABIT LAN CONSISTS OF SIMPLE INTERFACES RUNNING AT DATA RATES IN THE VICINITY OF 100 MB/S, FIBER-OPTIC LINKS, A CROSSBAR SWITCHING MATRIX, AND A NETWORK CONTROLLER ATTACHED TO A LOW SPEED LAN. GIGABIT OVERALL THROUGHPUT IS ACHIEVED WITH LOW SPEED AND LOW COST INTERFACES BY USING PARALLEL DATA TRANSFER THROUGH THE SWITCH. THE NETWORK OPERATES IN A CIRCUIT SWITCHED MODE FOR THE TRANSFER OF LARGE FILES OR LONG MESSAGES BETWEEN SYSTEMS SUCH AS WORKSTATIONS, DISPLAYS, MASS STORAGE DEVICES, SPECIAL PURPOSE PROCESSORS, ETC. THE COST OF HARDWARE IS EXPECTED TO BE MUCH LESS THAN LARGE-SCALE INTEGRATED GIGABIT NETWORK NODES THAT ARE STILL YEARS AWAY. THE DESIGN EMPHASIZES LOW-COST, STANDARD, READILY AVAILABLE ELECTRONIC AND OPTOELECTRONIC COMPONENTS, AND EASE OF INTERFACE TO EXISTING SYSTEMS. IN THIS PHASE I SBIR STUDY, WE DEVELOP PROTOCOLS, OPERATIONAL SPECIFICATIONS, COMPLETE A HIGH LEVEL DESIGN, HARDWARE DESIGN AND SOFTWARE FUNCTIONAL DESIGN, ANALYZE THE PERFORMANCE AND SIMULATE THE NETWORK. PHASE II INCLUDES THE CONSTRUCTION OF A SMALL-SCALE PROTOTYPE SYSTEM, AND ASSOCIATED CONTROL AND INTERFACE ELECTRONICS AND SOFTWARE. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - DISTRIBUTED COMPUTING SYSTEMS CAN SHARE RESOURCES AND ACHIEVE THEIR HIGHEST PERFORMANCE WHEN PROCESSORS ARE INTERCONNECTED WITH THE LOW-COST GIGABIT NETWORK PROPOSED. THERE ARE EXTENSIVE MILITARY AND COMMERCIAL APPLICATIONS IN PARALLEL COMPUTING, SIGNAL PROCESSING AND TELECOMMUNICATIONS, INCLUDING: IMAGING RADAR; TRACKING; PATTERN RECOGNITION; AND SYSTEMS WITH DISTRIBUTED DATA GATHERING, PROCESSING AND STORAGE. KEY WORDS - HIGH SPEED NETWORKS, CROSSBAR NETWORKS, GIGABIT NETWORKS,

PHYSICAL OPTICS CORP  
20600 GRAMERCY PL - STE 103  
TORRANCE, CA 90591  
Program Manager: DR FREDDIE LIN  
Contract #:

Title: WDM MULTI-HOP LANS USING EFFICIENCY HOLOGRAPHIC MATRICES

Topic #: DARPA90-081

Office:

ID #: 42506

UTILIZING THE HUGE POTENTIAL BANDWIDTH OF OPTICAL FIBER BASED NETWORKS REQUIRES DEVELOPING TECHNOLOGIES WHICH ENABLE A LARGE NUMBER OF USERS TO COMMUNICATE SIMULTANEOUSLY OVER A LARGE AREA AT HIGH BIT RATES. UNFORTUNATELY, TDM AND CDMA ARE BOTH RESTRICTED BY ELECTRONICS WHICH PLACES A FUNDAMENTAL LIMITATION OF APPROXIMATELY 1-10 GB/S ON THROUGHPUT. TRADITIONAL WDM, HOWEVER, ALLOWS A HIGH LEVEL OF CONCURRENCY BETWEEN USERS AND COULD POTENTIALLY ACHIEVE 10-100 GB/S NETWORK THROUGHPUT. TECHNOLOGICAL DIFFICULTIES IN ACHIEVING BROAD-BAND TUNABLE LASER DIODES, OPTICAL FILTERS, AND DIFFICULTIES IN STABILIZING THE WAVELENGTHS IN GREAT NUMBERS OF WIDELY DISTRIBUTED LASER DIODES MAKE THIS SCHEME APPEAR AT LEAST 5-10 YEARS AWAY. INNOVATIVE IDEAS IN MULTI-HOP NETWORKS COMBINING THE PARALLELISM OF PARALLEL PROCESSING WITH THE EFFICIENCY OF PACKET SWITCHED LANS ALLOW A

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HIGH LEVEL OF CONCURRENCY WITH FEW OF THE FUNDAMENTAL OR TECHNOLOGICAL LIMITATIONS THAT PLAGUE THE ABOVE APPROACHES. POC'S APPROACH COMBINES THE FLEXIBILITY OF FREE-SPACE OR WAVEGUIDE-BASED HOLOGRAPHIC TECHNIQUES WITH THE MULTI-HOP NETWORK DESIGN TO REDUCE POWER LOSSES AND TO INCREASE INTERCONNECTIVITY. THIS LEADS TO INCREASED ROBUSTNESS, LOWER COST, AND INCREASED MAINTAINABILITY DUE TO A NUMBER OF REDUNDANT PATHS AND THE LIMITING OF THE NUMBER OF LASER DIODE WAVELENGTHS NEEDED. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - WDM MULTI-HOP NETWORKS HAVE WIDE RANGING APPLICABILITY TO BOTH MILITARY AND COMMERCIAL MARKETS. THESE DESIGNS PRESENT A VIRTUALLY LIMITLESS EXPANSION AS A SUPER HIGH SPEED FIBER OPTIC BACKBONE BOTH IN MAN APPLICATIONS AND TACTICAL/STRATEGIC MILITARY NETWORKS. KEY WORDS - FIBER NETWORKS, MULTI-HOP NETWORKS, WDM, TB/S NETWORKS

VOTAN

4487 TECHNOLOGY DR

FREMONT, CA 94538

Program Manager: DR STEPHEN GILL

Contract #:

Title: AUDITORY MODEL SIGNAL PROCESSING FOR SPEECH RECOGNITION

Topic #: DARPA90-083

Office:

ID #: 42526

STATE-OF-THE-ART VOICE RECOGNITION TECHNOLOGY IS BASED ON MATCHING SPECTRAL VOICE PATTERNS (ACOUSTIC ENERGY AS A FUNCTION OF TIME AND FREQUENCY). THE SIGNAL PROCESSING REQUIREMENTS OF SPECTRAL PATTERN MATCHING ARE CURRENTLY SERVED BY SPECIAL PURPOSE FILTER BANKS OR DIGITAL TRANSFORMS PERFORMED ON HIGH PERFORMANCE DSP CHIPS. FOR SEVERAL YEARS VOTAN HAS BEEN PERFORMING AN IN-DEPTH STUDY OF THE HUMAN AUDITORY SYSTEM TO OBTAIN A BETTER UNDERSTANDING OF HOW SIGNALS ARE PROCESSED AND SPEECH FEATURES EXTRACTED BY A HUMAN BEING. AS PART OF THIS RESEARCH, DETAILED MATHEMATICAL MODELS OF THE PHYSICS, CHEMISTRY, AND NEUROPHYSIOLOGY OF THE AUDITORY SYSTEM HAVE BEEN DEVELOPED AND COMPARED WITH AVAILABLE EXPERIMENTAL DATA. THIS RESEARCH HAS DEMONSTRATED THAT THE SIGNAL PROCESSING AND FEATURE EXTRACTION PROCESS IN A HUMAN BEING ARE RADICALLY DIFFERENT FROM THE SPECTRAL PATTERN APPROACH OF CURRENT VOICE RECOGNITION SYSTEMS. THE AUDITORY SYSTEM IS EXTREMELY SENSITIVE TO FEATURES NOT PRESENT IN THE SPECTRAL PATTERN (PRINCIPALLY PHASE AND TIMING FEATURES), AND CONVERSELY IS INSENSITIVE TO FEATURES THAT ARE PROMINENT IN THE SPECTRAL PATTERN. THESE DIFFERENCES ARE OF VITAL IMPORTANCE FOR ACCURATE SPEECH RECOGNITION. THE OBJECTIVE OF THE PROPOSED PHASE I EFFORT IS TO DETERMINE THE FEASIBILITY OF DEVELOPING A PREPROCESSOR FOR SPEECH RECOGNITION WHICH INCORPORATES AS ACCURATELY AS POSSIBLE A MODEL OF THE HUMAN AUDITORY SYSTEM. THIS PREPROCESSOR WOULD PERFORM THE FUNCTIONS OF THE OUTER EAR, THE MIDDLE EAR, THE INNER EAR (COCHLEA), HAIR CELL NEURAL TRANSDUCTION, AND NEURAL SIGNAL PROCESSING IN THE COCHLEAR NUCLEUS. THE OUTPUT OF THE PREPROCESSOR WOULD BE ACOUSTIC FEATURES SUITABLE FOR SPEECH RECOGNITION SYSTEMS USING EITHER CONVENTIONAL PATTERN MATCHING TECHNIQUES OR THE NEWER NEURAL NET TECHNIQUES. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - SPEECH RECOGNITION IS AN EXTREMELY IMPORTANT AREA FOR BOTH COMMERCIAL AND DEFENSE APPLICATIONS. RECOGNITION ACCURACY, PARTICULARLY FOR LARGE VOCABULARY, CONTINUOUS, SPEAKER INDEPENDENT RECOGNITION OVER

INFOLOGIC SOFTWARE INC

1223 PEOPLE AVE - STE 5405

TROY, NY 12180

Program Manager: DONALD HAMILTON

Contract #:

Title: DESIGN OF A VLSI CAD FRAMEWORK TO SUPPORT TECHNOLOGY TRANSFER TO LOW POWER CMOS TOOLS

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Topic #: DARPA90-089

Office:

ID #: 42488

ONLY A FRACTION OF UNIVERSITY RESEARCH IN VLSI CAD IS SUCCESSFULLY TRANSFERRED TO THE COMMERCIAL MARKET. WEAK USER INTERFACE OF THE UNIVERSITY RESEARCH IS ONE OF THE REASONS PREVENTING TECHNOLOGY TRANSFER. WE PROPOSE TO DEVELOP A FRAMEWORK TO BE DESIGNED AS A SHELL ON TOP OF EXISTING LOW POWER CMOS UNIVERSITY DESIGN TOOLS. THIS FRAMEWORK WILL BE A CONSISTENT, INTERACTIVE, GRAPHICAL USER INTERFACE FOR THE DESIGN TOOLS. THE TOOL WILL ALSO ADD SIGNIFICANT FUNCTIONALITY IN THREE AREAS: 1) THE USER WILL BE ABLE TO QUERY DESIGN DATA IN A "HYPERTEXT-LIKE" FASHION. THIS QUERY CAPABILITY WILL BE VALUABLE FOR THE PREPARATION OF DESIGN DOCUMENTATION. 2) THE USER WILL HAVE A GRAPHICAL SHELL TO CONTROL THE EXECUTION OF DESIGN TOOLS. 3) THE SYSTEM WILL PERFORM DESIGN MANAGEMENT TO INSURE THAT DESIGNS ARE COMPLETE AND CONSISTENT. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - PREPARE LOW POWER CMOS UNIVERSITY VLSI CAD TOOLS FOR THE COMMERCIAL MARKET BY BRINGING THEM UNDER A GRAPHICAL FRAMEWORK WHICH IMPROVES THE FUNCTIONALITY OF THE TOOLS. KEY WORDS - LOW POWER, CMOS, VLSI, CAD, TECHNOLOGY TRANSFER.

LIGHT SCULPTING INC  
4815 N MARLBOROUGH DR  
MILWAUKEE, WI 53217  
Program Manager: DR EFREM FUDIM  
Contract #:

Title: RAPID PROTOTYPING OF ELECTROMECHANICAL SYSTEMS BY PRINTED INTEGRATED FABRICATION

Topic #: DARPA90-092

Office:

ID #: 42495

THE PROJECT IS AIMED AT DEVELOPING A NEW TECHNOLOGY FOR PRINTED INTEGRATED FABRICATION OF ELECTROMECHANICAL SYSTEMS (INCLUDING MULTI-LAYER ELECTRIC CIRCUIT BOARDS AS WELL AS OPTOELECTROMECHANICAL DEVICES SUCH AS AIRCRAFT/VEHICLE INSTRUMENT PANELS) AS A MONOLITHIC OBJECT USING A FAST LOW-COST AUTOMATABLE PROCESS THAT IS HIGHLY EFFICIENT FOR PROTOTYPING. THE PROCESS IS BASED ON SOLIDIFICATION OF LIQUID PHOTOPOLYMERS WITH IRRADIATION THAT HAS BEEN RECENTLY INTRODUCED FOR MECHANICAL PROTOTYPING. THE IRRADIATION WILL BE CONTROLLED BY OBJECT DESIGN DATA COMING FROM A MECHANICAL CAD (COMPUTER-AIDED-DESIGN) SYSTEM THAT, IN TURN, CAN BE DIRECTED BY AN ELECTROMECHANICAL CAD SYSTEM SO THAT THE WHOLE PROCESS FROM SYSTEM DESIGN THROUGH ITS PROTOTYPING AND FABRICATION CAN BE AUTOMATED YIELDING A TURNKEY SYSTEM. PHASE I PROGRAM WILL BE DIRECTED TOWARDS REFINING THE APPROACH, INVESTIGATING THE FEASIBILITY OF "PRINTING" BASIC COMPONENTS, AND ASSESSING THE SCOPE AND DEGREE OF APPLICABILITY OF THE APPROACH TO RAPID PROTOTYPING OF DIFFERENT TYPES OF ELECTROMECHANICAL SYSTEMS AND DEVICES. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - TENS AND HUNDREDS OF TIMES FASTER PROTOTYPING YIELDING DRASTICALLY ACCELERATED INTRODUCTION OF NEW PRODUCTS AND ENHANCED ECONOMIC COMPETITIVENESS OF THE NATION. PRINTED INTEGRATED FABRICATION INSURES TECHNOLOGICAL SUPERIORITY IN ENDLESS DEFENSE AND COMMERCIAL APPLICATIONS, AEROSPACE, VEHICLES, TV, ELECTRONICS, ELECTRIC APPLIANCES, E.G. KEY WORDS - RAPID PROTOTYPING, ELECTROMECHANICAL, THREE-DIMENSIONAL, PHOTOPOLYMER, SOLIDIFICATION, COMPUTER-AIDED-DESIGN, PRINTED

SYSTEMS & PROCESSES ENGR (SPEC)  
1406 SMITH RD  
AUSTIN, TX 78721  
Program Manager: DR GARY McMILLIAN  
Contract #:

Title: GaAs DATAPATH COMPILATION

Topic #: DARPA90-094

Office:

ID #: 42520

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SYSTEMS & PROCESSES ENGINEERING CORPORATION (SPEC) HAS DEVELOPED A PROGRAM TO DEMONSTRATE TECHNOLOGY INDEPENDENT COMPILER TECHNOLOGY. SPEC HAS A JOINT DEVELOPMENT AGREEMENT WITH VLSI TECHNOLOGY AND WITH VITESSE SEMICONDUCTOR TO DEVELOP GaAs DATAPATH "LEAF CELLS" FOR USE WITH VLSI TECHNOLOGY'S DATAPATH COMPILER. THE DATAPATH COMPILER USES TECHNOLOGY SPECIFIC LEAF CELLS TO CONSTRUCT OPTIMIZED N-Bi DATAPATHS FROM TECHNOLOGY INDEPENDENT SCHEMATIC DESIGNS. THE COMPILED LAYOUT OFFERS HIGHER PERFORMANCE, LOWER POWER AND SMALLER SIZE THAN STANDARD CELL OR GATE ARRAY BASED DESIGNS. INITIAL DEVELOPMENT WILL BE FOR VITESSE'S DIRECT COUPLED FET LOGIC (DCFL) ENHANCEMENT/DEPLETION MODE GaAs PROCESS. DCFL CAN BE USED TO DESIGN HIGH SPEED, LOW POWER GaAs LOGIC, AND INTEGRATION LEVELS ARE PROJECTED TO REACH 100K EQUIVALENT NOR GATES BY THE END OF 1990. A BASIC SET OF DCFL ELEMENT CELLS WILL BE DEVELOPED (E.G. ALU, BARREL SHIFTER, REGISTER FILE, ADDER, MULTIPLEXOR, FLIP-FLOP, LATCH). DEVELOPMENT OF SOURCE COUPLED FET LOGIC (SCFL) LEAF CELLS WILL BE INVESTIGATED FOR APPLICATIONS THAT REQUIRE VERY HIGH SPEED GaAs DATAPATH LOGIC. SCFL OFFERS HIGHER SPEED AT THE EXPENSE OF INCREASED POWER CONSUMPTION AND LARGER LEAF CELLS. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - DEVELOPMENT OF GaAs DATAPATH LEAF CELLS WILL ENABLE INTEGRATED CIRCUIT DESIGNERS TO IMPLEMENT DESIGNS IN EITHER CMOS OR GaAs, AFTER COMPLETION OF THE FUNCTIONAL DESIGN. UPON COMPLETION OF THIS PROGRAM, FUNCTIONAL LEVEL ASIC DESIGNS CAN BE TRANSPARENTLY IMPLEMENTED IN GaAs OR CMOS, AS REQUIRED TO ACHIEVE OPTIMIZED SYSTEM PERFORMANCE, E.G. HIGHER PERFORMANCE OR LOWER POWER CONSUMPTION. KEY WORDS - GALLIUM ARSENIDE, GaAs, DATAPATH COMPILER, LOGIC SYNTHESIS, CAE.

BLACKBOARD TECHNOLOGY GP  
401 MAIN ST  
AMHERST, MA 01002  
Program Manager: DANIEL CORKILL  
Contract #:

Title: MIXED-PARADIGM CASE-BASED REASONING USING A BLACKBOARD ARCHITECTURE  
Topic #: DARPA90-097                      Office:                      ID #: 42458

CASE-BASED REASONING (CBR) INVOLVES THE USE OF SUITABLE CASES OF PAST EXPERIENCE TO INTERPRET OR SOLVE A NEW PROBLEM. THIS PROPOSED WORK EXPLORES INCORPORATING CBR TECHNIQUES IN MIXED-PARADIGM KNOWLEDGE-BASED APPLICATIONS. IN MANY POTENTIAL CBR APPLICATIONS, CBR APPROACHES ALONE ARE INSUFFICIENT AND MUST BE COMBINED WITH OTHER PROBLEM-SOLVING TECHNIQUES IN A MIXED-PARADIGM CBR FRAMEWORK. OUR APPROACH TO MIXED-PARADIGM CBR IS TO USE A BLACKBOARD ARCHITECTURE AS AN INTEGRATION FRAMEWORK FOR CASE-BASED KNOWLEDGE SOURCES (KSS) OPERATING WITH KSS USING OTHER PROBLEM-SOLVING APPROACHES. THE OPPORTUNISTIC CONTROL CAPABILITIES OF THE BLACKBOARD PARADIGM ARE WELL SUITED TO MIXED-PARADIGM PROBLEM SOLVING. CBR AND THE BLACKBOARD PARADIGM ALSO SHARE FEATURES THAT FACILITATE AND EXTEND THE CAPABILITIES OF SUCH INTEGRATION BEYOND THE MERE SUPPORT OF KSS EMPLOYING CBR TECHNIQUES. THESE SIMILARITIES INCLUDE: INDEXING AND RETRIEVAL (CASE S AND BLACKBOARD OBJECTS), RELATIVELY LARGE-GRAINED CONTROL DECISIONS (CASE SELECTION AND KS EXECUTION) WE WILL BUILD ON THESE SIMILARITIES TO DEVELOP A FLEXIBLE, MIXED-PARADIGM CBR FRAMEWORK BASED ON THE BLACKBOARD ARCHITECTURE. IN THE PROCESS WE WILL ADDRESS ISSUES IN CBR INDEXING AND RETRIEVAL AND IN CONTROL OF MIXED-PARADIGM CBR APPLICATIONS. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - THE PROPOSED WORK WILL RESULT IN A FLEXIBLE FRAMEWORK FOR MIXED-PARADIGM CBR APPLICATIONS BASED ON THE BLACKBOARD ARCHITECTURE. IT WILL EXPAND THE USE OF CBR TO APPLICATION AREAS THAT ARE NOT COMPLETELY SUITED TO CBR TECHNIQUES AND WILL INCREASE UNDERSTANDING OF THE SYNERGY BETWEEN CBR AND OTHER PROBLEM-SOLVING PARADIGMS. THE WORK WILL ALSO PROVIDE EXAMPLES OF MIXED-PARADIGM CBR APPLICATIONS. MIXED-PARADIGM CBR IS EXPECTED TO PLAY A SIGNIFICANT ROLE IN FUTURE GOVERNMENT AND COMMERCIAL APPLICATIONS. KEY WORDS - CASE-BASED REASONING, MIXED-PARADIGM PROBLEM SOLVING,

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**DARPA Solicitation 90.2**

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COGNITIVE SYSTEMS INC  
234 CHURCH ST  
NEW HAVEN, CT 06510  
Program Manager: RALPH BARLETTA

Contract #:

Title: TEMPORAL REASONING IN A CASE-BASED REASONING SYSTEM

Topic #: DARPA90-097

Office:

ID #: 41622

CASE-BASED REASONING (CBR) IS A POWERFUL PARADIGM FOR BUILDING EXPERT SYSTEMS WITH MANY ADVANTAGES OVER OTHER APPROACHES IN TERMS OF TIME AND COST OF KNOWLEDGE ENGINEERING, EASE OF MODIFICATION OF THE SYSTEM, AND ABILITY TO CAPTURE EXPERT KNOWLEDGE IN DOMAINS WHERE STRONG DOMAIN THEORIES DO NOT EXIST. MANY CBR SYSTEMS DO A GOOD JOB OF HANDLING STATIC CASES (I.E., CASES THAT REPRESENT A SINGLE POINT IN TIME), BUT DO NOT HAVE FACILITIES FOR DOING TEMPORAL REASONING ACROSS A SET OF CASES. COGNITIVE SYSTEMS PROPOSES TO EXTEND ITS CURRENT CBR SHELL (SEE SECTION F. RELATED WORK) TO INCLUDE USER-FRIENDLY FACILITIES FOR DOING TEMPORAL REASONING. COGNITIVE HAS ALREADY DEVELOPED A GENERIC CBR SHELL WHICH IS CAPABLE OF LIMITED TEMPORAL REASONING (SIMPLE SEQUENCING) AND HAS USED THAT TOOL TO DEVELOP A CASE-BASED NATURAL LANGUAGE PARSER. WE ARE ALSO INVOLVED IN ONGOING DEVELOPMENT OF A MACHINE FAULT DIAGNOSIS SYSTEM WITH LOCKHEED AND OF A NETWORK FAILURE DIAGNOSIS SYSTEM WITH APPLE. BOTH OF THESE PROJECTS HAVE TEMPORAL ISSUES THAT MUST BE ADDRESSED. COGNITIVE WILL USE THE EXPERIENCE GAINED FROM THESE PROJECTS TO GUIDE DEVELOPMENT OF POWERFUL NEW FEATURES TO AID TEMPORAL REASONING. NEW FEATURES WILL INCLUDE INTERFACES TO FACILITATE SPECIFICATION AND MANIPULATION OF TEMPORAL LINKS, AND ENHANCEMENTS TO INDEX GENERATION TO FULLY EXPLOIT ANY TEMPORAL INFORMATION WHICH WILL BE AVAILABLE. IN ADDITION, COGNITIVE WILL USE THE EXISTING CASE-BASES AS A TEST BED FOR THE NEW FEATURES. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - INCORPORATING TEMPORAL REASONING ABILITIES INTO A CBR SHELL WILL ENABLE THE SHELL TO BE USED IN A WIDE RANGE OF APPLICATIONS AND DOMAINS WHERE REASONING ABOUT TIME IS SIGNIFICANT. IN ADDITION, BUILDING EFFECTIVE INTERFACES FOR REPRESENTING TEMPORAL INFORMATION WILL RESULT IN A REDUCTION IN KNOWLEDGE ENGINEERING TIME REQUIRED TO SPECIFY AND TAKE ADVANTAGE OF TEMPORAL INFORMATION. KEY WORDS - ARTIFICIAL INTELLIGENCE, CASE-BASED REASONING, EXPERT SYSTEMS, TEMPORAL REASONING, PARSING, FAULT DIAGNOSIS.

COGNITIVE SYSTEMS INC  
234 CHURCH ST  
NEW HAVEN, CT 06510  
Program Manager: RALPH BARLETTA

Contract #:

Title: TEMPORAL REASONING IN A CASE-BASED REASONING SYSTEM

Topic #: DARPA90-097

Office:

ID #: 42463

CASE-BASED REASONING (CBR) IS A POWERFUL PARADIGM FOR BUILDING EXPERT SYSTEMS WITH MANY ADVANTAGES OVER OTHER APPROACHES IN TERMS OF TIME AND COST OF KNOWLEDGE ENGINEERING, EASE OF MODIFICATION OF THE SYSTEM, AND ABILITY TO CAPTURE EXPERT KNOWLEDGE IN DOMAINS WHERE STRONG DOMAIN THEORIES DO NOT EXIST. MANY CBR SYSTEMS DO A GOOD JOB OF HANDLING STATIC CASES (I.E., CASES THAT REPRESENT A SINGLE POINT IN TIME), BUT DO NOT HAVE FACILITIES FOR DOING TEMPORAL REASONING ACROSS A SET OF CASES. COGNITIVE SYSTEMS PROPOSES TO EXTEND ITS CURRENT CBR SHELL (SEE SECTION F. RELATED WORK) TO INCLUDE USER-FRIENDLY FACILITIES FOR DOING TEMPORAL REASONING. COGNITIVE HAS ALREADY DEVELOPED A GENERIC CBR SHELL WHICH IS CAPABLE OF LIMITED TEMPORAL REASONING (SIMPLE SEQUENCING) AND HAS USED THAT TOOL TO DEVELOP A CASE-BASED NATURAL LANGUAGE PARSER. WE ARE ALSO INVOLVED IN ONGOING DEVELOPMENT OF A MACHINE FAULT DIAGNOSIS SYSTEM WITH LOCKHEED AND OF A NETWORK FAILURE DIAGNOSIS SYSTEM WITH APPLE. BOTH OF THESE PROJECTS HAVE TEMPORAL ISSUES THAT MUST BE ADDRESSED. COGNITIVE WILL USE THE EXPERIENCE GAINED FROM THESE PROJECTS TO GUIDE DEVELOPMENT OF POWERFUL NEW

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DARPA Solicitation 90.2

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FEATURES TO AID TEMPORAL REASONING. NEW FEATURES WILL INCLUDE INTERFACES TO FACILITATE SPECIFICATION AND MANIPULATION OF TEMPORAL LINKS, AND ENHANCEMENTS TO INDEX GENERATION TO FULLY EXPLOIT ANY TEMPORAL INFORMATION WHICH WILL BE AVAILABLE. IN ADDITION, COGNITIVE WILL USE THE EXISTING CASE-BASES AS A TEST BED FOR THE NEW FEATURES. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - INCORPORATING TEMPORAL REASONING ABILITIES INTO A CBR SHELL WILL ENABLE THE SHELL TO BE USED IN A WIDE RANGE OF APPLICATIONS AND DOMAINS WHERE REASONING ABOUT TIME IS SIGNIFICANT. IN ADDITION, BUILDING EFFECTIVE INTERFACES FOR REPRESENTING TEMPORAL INFORMATION WILL RESULT IN A REDUCTION IN KNOWLEDGE ENGINEERING TIME REQUIRED TO SPECIFY AND TAKE ADVANTAGE OF TEMPORAL INFORMATION. DEMONSTRATING THE FEASIBILITY OF ADDING TEMPORAL REASONING CAPABILITIES TO A COMMERCIAL

MULTISPEC CORP  
25 BLACK LATCH LN  
CHERRY HILL, NY 08003  
Program Manager: DR DAVID SHELBY  
Contract #:  
Title: NONLINEAR SIGNAL PROCESSING ALGORITHMS FOR ENHANCED C3I APPLICATIONS  
Topic #: DARPA90-098                      Office:                      ID #: 42499

THERE IS A GROWING INTEREST IN THE ROLE OF NONLINEAR SIGNAL PROCESSING (NSP) ALGORITHMS UTILIZING HIGHER-ORDER MOMENTS AND HIGHER-ORDER SPECTRAL MEASUREMENTS FOR FERRETING OUT INFORMATION ABOUT UNKNOWN SIGNALS THAT ARE BEYOND THE REACH OF LINEAR TECHNIQUES. NSP TECHNIQUES DISSECT HIGHER ORDER STATISTICAL SIGNAL STRUCTURE WHICH PERMIT ENHANCED DIFFERENTIATION FROM BACKGROUND. UNLIKE HEURISTICS, NSP OFFER RIGOROUS METHODS TO IDENTIFY AND EXTRACT INFORMATION NOT AVAILABLE FROM LINEAR TECHNIQUES, E.G., THE FFT IS BLIND TO CERTAIN INFORMATION THAT CAN ONLY BE EXTRACTED BY MULTISPECTRA, I.E., "HIGHER-ORDER" SPECTRA. PHASE I DEMONSTRATES THE UTILITY OF FUNDAMENTAL NSP TECHNIQUES UNDERLYING ENHANCED DETECTION/CLASSIFICATION OF BROADBAND SIGNALS EMANATING FROM NONLINEAR SOURCES. THE PROBLEMS ARE: NONLINEAR SYSTEMS WHICH ARE ACTIVELY PROBED, OR PASSIVELY MONITORED, THE LATTER BEING MORE DIFFICULT AND REPRESENTING TWO FUNDAMENTAL PROBLEMS IN DOD SURVEILLANCE REQUIREMENTS: DETECTION AND CLASSIFICATION. A CASE STUDY USES SPREAD-SPECTRUM EMITTERS BECAUSE OF THEIR IMPORTANCE AND BECAUSE THEY GENERATE BROADBAND SIGNALS FROM AN INHERENT NONLINEAR SIGNAL GENERATION MECHANISM. PHASE I DEMONSTRATES THE UTILITY OF THE NSP ALGORITHMS, USING A SET OF PREVIOUSLY SBIR FUNDED NSP DISCRIMINANTS; AND WILL DEVELOP HIGH SPEED COMPUTING ARCHITECTURES FOR NSP APPLICATIONS. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - RECOGNITION OF THE IMPORTANCE OF NSP ALGORITHMS TO PROBLEMS TO DOD. A CHIP ARCHITECTURE FOR HIGH SPEED IMPLEMENTATION OF A FUNDAMENTAL NSP ALGORITHMS FOR PIGGYBACK ENHANCEMENT OF DOD SENSOR PLATFORMS WITHOUT MODIFICATION OF FRONT INSTRUMENTATION, AND SPECTROSCOPY. KEY WORDS - BISPECTRUM, NONLINEAR, MULTISPECTRA, SPREAD SPECTRUM, VOLTERRA.

RGB ASSOCS  
PO BOX 8  
WAYLAND, MA 01778  
Program Manager: RICHARD BARAKAT  
Contract #:  
Title: WIDE BAND VIDEO DATA COMPRESSION  
Topic #: DARPA90-100                      Office:                      ID #: 42513

WE PROPOSE TO DESIGN AND SIMULATE A MASSIVELY PARALLEL DATA COMPRESSION SYSTEM FOR WIDE BAND VIDEO THAT IS CAPABLE OF PROCESSING DATA STREAMS OF 1 BILLION BITS PER SECOND IN REAL TIME. THE WORK PROPOSED HERE PROVIDES THE BASIS FOR A SUBSEQUENT PHASE II PROPOSAL TO BUILD



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THIS HARDWARE. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - HIGH SPEED COMMUNICATIONS, MASS DATA STORAGE. KEY WORDS - DATA COMPRESSION, MASSIVELY PARALLEL ALGORITHMS, REAL-TIME VIDEO, COMMUNICATIONS, MASS STORAGE, HIGH PERFORMANCE HARDWARE

PHYSICAL OPTICS CORP  
20600 GRAMERCY PL - STE 103  
TORRANCE, CA 90501  
Program Manager: JHY-MING LUO  
Contract #:  
Title: COHERENT COUPLING OF MULTIPLE LASER DIODE ARRAYS BY INJECTION LOCKING  
Topic #: DARPA90-104                      Office:                      ID #: 42507

PHYSICAL OPTICS CORPORATION (POC) PROPOSES A COMPACT, LIGHT-WEIGHT, HIGH-EFFICIENCY AND HIGH-POWER COHERENT OPTICAL SOURCE SYSTEM. THIS SYSTEM WILL CONSIST OF MULTIPLE SLAVE DIODE LASERS (OR ARRAYS) FREQUENCY-LOCKED TO A WELL-CONTROLLED MASTER DIODE LASER WHICH WILL OPERATE AT A SINGLE LONGITUDINAL MODE WITH A NARROW LINEWIDTH. FREQUENCY LOCKING BETWEEN THE MASTER AND SLAVES CAN BE OBTAINED BY TUNING THEIR TEMPERATURES AND BIAS CURRENTS IN SUCH A WAY THAT THEIR FREE-RUNNING FREQUENCY SEPARATION IS WITHIN THE LOCKING BANDWIDTH. POC PLANS TO USE THE MULTIGRATING HOLOGRAM FAN-OUT EFFECT FOR A SIMULTANEOUS LOCKING OF SEVERAL SLAVE DIODE LASERS (OR ARRAYS) TO A SINGLE MASTER LASER. THE OPTICAL OUTPUTS OF THE LOCKED SLAVES EMITTING A SINGLE-LOBE FAR-FIELD AT MASTER LASER FREQUENCY ARE COHERENTLY COMBINED THROUGH THE FAN-IN FUNCTION OF THE MULTIGRATING HOLOGRAM, WHICH ALSO SERVES AS A SPECTRAL AND SPATIAL FILTER BY BRAGG LAW. INCREASING THE SLAVE LASER NUMBERS WILL BOOST THE AVAILABLE COHERENT POWERS OF THIS SYSTEM. IT IS POSSIBLE TO FURTHER ENHANCE COHERENT OUTPUT POWER BY LOCKING SEVERAL SYSTEMS TOGETHER. AN OEIC DESIGN OF THIS SYSTEM IS EXPECTED WHICH WILL HAVE A SURFACE EMITTING FEATURE ACHIEVED THROUGH INCORPORATING GRATINGS OR MICROLENSES. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - THE PROPOSED TECHNIQUE CAN PROVIDE A HIGH-POWER COHERENT OUTPUT WITH A DIFFRACTION-LIMITED SINGLE-LOBE FAR FIELD AT A SINGLE AND NARROW SPECTRAL LINE. THIS COMPACT AND HIGH-EFFICIENCY COHERENT OPTICAL SOURCE HAS POTENTIAL FOR FREE-SPACE COMMUNICATION, OPTICAL PUMPING, NONLINEAR OPTICS, PARALLEL OPTICAL SIGNAL PROCESSING, OPTICAL COMPUTING AND NUMEROUS TACTICAL APPLICATIONS. KEY WORDS - COHERENT COUPLING, DIODE LASER, INJECTION LOCKING, MULTIGRATING HOLOGRAM

OME TECHNOLOGY INC  
3461 1/2 VIRGINIA RD  
LOS ANGELES, CA 90016  
Program Manager: DR MILTON BIRNBAUM  
Contract #:  
Title: DEVELOPMENT OF PASSIVE Q-SWITCHES FOR MID-INFRARED ERBIUM SOLID STATE LASERS  
Topic #: DARPA90-105                      Office: DSO                      ID #: 50329

WE PROPOSE TO INVESTIGATE THE POTENTIAL FOR USING MATERIALS THAT CONTAIN HYDROXY GROUPS AND/OR OH STRETCHING BANDS AS PASSIVE Q-SWITCHES FOR MID-INFRARED ERBIUM SOLID STATE LASERS. IMPORTANT PROPERTIES OF PASSIVE Q-SWITCH MATERIALS INCLUDE THE ABSORPTION CROSS SECTION AT THE LASER WAVELENGTH AND THE SATURATION INTENSITY AT WHICH THE MATERIAL BECOMES TRANSPARENT TO THE INCIDENT LASER RADIATION. IN THIS RESEARCH PROGRAM, EFFORT WILL BE MADE TO ESTABLISH MATERIAL REQUIREMENTS FOR PASSIVELY Q-SWITCHING MID-INFRARED Er:YAG AND (Cr, Er):YSGG LASERS AND DEMONSTRATE THE Q-SWITCHED OPERATION. A NUMBER OF CANDIDATE MATERIALS WILL BE EXAMINED AND THOSE THAT ARE SUITABLE FOR HIGH REPETITION RATE, HIGH PEAK POWER MID-INFRARED LASER RADIATION WILL BE IDENTIFIED. A Q-SWITCH CELL MADE OF APPROPRIATE IR MATERIALS AND WITH EASILY ADJUSTABLE THICKNESS WILL BE DESIGNED AND FABRICATED FOR USE

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IN THE LIQUID Q-SWITCH MATERIAL CHARACTERIZATION STUDIES AND Q-SWITCHING DEMONSTRATION EXPERIMENTS. IN Q-SWITCHING EXPERIMENTS, ATTENTION WILL BE PAID TO THE EFFECT OF SUCH FACTORS AS Q-SWITCH THICKNESS, FLASHLAMP INPUT ENERGY AND REFLECTIVITY OF THE OUTPUT COUPLER ON Q-SWITCHED OUTPUT CHARACTERISTICS.

JAMAR TECHNOLOGY CO  
3956 SORRENTO VALLEY BLVD  
SAN DIEGO, CA 92121  
Program Manager: DR HARRY SHIELDS  
Contract #:  
Title: PORTABLE UV LASER-INDUCED FLUORESCENCE IMAGING SENSOR  
Topic #: DARPA90-106                      Office:                      ID #: 42491

A PROGRAM IS PROPOSED TO EVALUATE THE FEASIBILITY OF USING LASER-INDUCED FLUORESCENCE AS A MEANS OF DETECTING CHEMICAL AGENTS. TARGET IDENTIFICATION WILL BE ACHIEVED BY USING AN INTENSIFIED VIDEO CAMERA TO CAPTURE FLUORESCENCE IMAGES GENERATED WHEN A UV LASER ILLUMINATES THE TARGET VOLUME. THE PHASE I PROGRAM WILL ADDRESS THE LASER TRANSMITTER, RECEIVER, VIDEO CAMERA, IMAGE PROCESSING AND SYSTEM INTEGRATION ISSUES LEADING TO A CONCEPTUAL DESIGN OF A PORTABLE SYSTEM. THE SENSOR WILL BE BASED ON AN ELEVEN (11) POUND, COMMERCIALY AVAILABLE, DIODE-PUMPED SOLID-STATE LASER. THE LASER IS A TRIPLED, ND:YAG DEVICE, OPERATING AT 355 NM, AND WILL BE USED AS THE TRANSMITTER OF THE PROPOSED SYSTEM. STUDIES OF LASER-INDUCED FLUORESCENCE FROM LABORATORY SAMPLES WILL BE CARRIED OUT TO CHARACTERIZE FLUORESCENCE SPECTRA AND EFFICIENCY. THIS DATA WILL BE INCLUDED IN A SIGNAL-TO-NOISE MODEL WHICH WILL PREDICT THE EXPECTED IMAGING PERFORMANCE OF THE SENSOR AS A FUNCTION OF SYSTEM PARAMETERS AND TARGET RANGE. THE SIGNAL-TO-NOISE PREDICTIONS AND SIZE AND WEIGHT ESTIMATES WILL BE THE PRIMARY CRITERIA TO ESTABLISH FEASIBILITY OF THE PROPOSED IMAGING SENSOR. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - THE PROPOSED RESEARCH WILL LEAD TO A NEW CAPABILITY IN IMAGING OF FLUORESCENT RETURNS FROM MILITARY AND COMMERCIAL TARGETS. EXAMPLES INCLUDE NARCOTIC CULTIVATION AND PRODUCTION, BIOLOGICAL AND CHEMICAL WARFARE AGENTS, MILITARY VEHICLES, CAMOUFLAGE, OIL SLICKS ON OCEANS, ENVIRONMENTALLY HAZARDOUS EMISSIONS, AND AGRICULTURAL PHENOMENA SUCH AS DROUGHT AND DISEASE. KEY WORDS - LASER-INDUCED FLUORESCENCE, IMAGING SENSOR, UV LASERS.

RAPIDAN RESEARCH CORP  
19151 STEDWICK DR  
GAITHERSBURG, MD 20879  
Program Manager: MICHAEL McMILLIAN  
Contract #:  
Title: REMOTE DETECTION OF DRUGS AND EXPLOSIVES BY TIME-DOMAIN SPECTROSCOPY  
Topic #: DARPA90-106                      Office:                      ID #: 42510

THIS PROJECT IS AN INVESTIGATION OF THE POSSIBILITY OF REMOTELY DETECTING ILLEGAL CHEMICAL SUBSTANCES SUCH AS DRUGS AND EXPLOSIVES BY MEANS OF ELECTROMAGNETIC PULSES. THE PULSES WOULD SCATTER FROM THESE SUBSTANCES AND PRODUCE SIGNATURES WHICH COULD BE RECOGNIZED. PHASE I OBJECTIVES ARE FIRST, TO MEASURE THE ELECTROMAGNETIC PROPERTIES OF SEVERAL OF THESE SUBSTANCES, AND TO SYNTHESIZE SIGNATURES THAT WOULD BE PRODUCED. SECOND, INVESTIGATIONS WOULD BE DONE ON THE EQUIPMENT AND ON THE DATA PROCESSING TECHNIQUES REQUIRED. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - THE METHOD WOULD PROVIDE A LESS EXPENSIVE AND MORE EFFECTIVE MEANS OF DETECTING THE ABOVE SUBSTANCES. THE APPARATUS COULD BE USED IN AIRPORTS, IN THE FIELD, AND FROM THE AIR. KEY WORDS - EXPLOSIVES DETECTION, DRUG DETECTION, IMPULSE RADAR, ELECTROMAGNETIC PULSE

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SPACE POWER INC  
621 RIVER OAKS PKWY  
SAN JOSE, CA 95134  
Program Manager: JOHN LAWLESS

Contract #:

Title: LASER REMOTE SENSING FOR DRUG INTERDICTION

Topic #: DARPA90-106

Office:

ID #: 42518

THERE IS A NATIONAL NEED FOR EFFICIENT MEANS OF LOCATING ILLEGAL DRUGS AND THEIR MANUFACTURING SITES. WE PROPOSE THE USE OF LASER REMOTE SENSING. DRUG MANUFACTURING SITES WOULD BE LOCATED BY SENSING THEIR ASSOCIATED CHEMICAL REAGENTS. THIS COULD LIKELY BE DONE WITH A LASER BEAM INVISIBLE TO THE EYE. REMOTE SENSING OF CHEMICALS USING LASERS IS UNRIVALED IN TERMS OF SENSITIVITY; SPECIES SELECTIVITY AND HIGH DATA RATE. SPECIES CONCENTRATIONS OF THE ORDER OF TEN PARTS PER BILLION IS ROUTINELY DETECTED USING LASER SENSORS. BY MATCHING THE CHARACTERISTICS OF THE LASER INDUCED SPECTRA OF THE SPECIES BEING STUDIED WITH KNOWN CHEMICALS, POSITIVE IDENTIFICATION IS POSSIBLE. WITH THE USE OF HIGH-REPETITION RATE LASERS TO SCAN THROUGH SUSPECTED AREAS, DATA COLLECTION AND ANALYSIS CAN BE PERFORMED INSTANTANEOUSLY. LASER-BASED REMOTE SENSORS SHOULD GREATLY ENHANCE THE CAPABILITY OF DRUG ENFORCEMENT. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - THE PROPOSED INSTRUMENT WOULD USE LASERS TO DETECT CHEMICAL AGENTS SUCH AS ILLEGAL DRUGS AND THEIR PRECURSOR CHEMICALS. IT WOULD BE SOLD TO LAW ENFORCEMENT AGENCIES. THREE APPLICATIONS ARE BEING CONSIDERED: (1) REMOTE DETECTION OF SOUTH AMERICAN DRUG MANUFACTURING SITES FROM AN AIRPLANE (OR SATELLITE), (2) REMOTE DETECTION OF SUBURBAN OR RURAL DRUG MANUFACTURING SITES IN THE U.S. FROM AN AIRPLANE, AND (3) DETECTION OF ILLEGAL DRUGS AS THEY PASS THROUGH CUSTOMS. KEY WORDS - DRUG INTERDICTION, LASER REMOTE SENSING, ILLEGAL DRUGS

CREARE INC  
PO BOX 71 - ETNA RD  
HANOVER, NH 03755  
Program Manager: KENT GOEKING

Contract #:

Title: SYNTHESIS OF ORIENTED FERROELECTRIC BISMUTH TITANATE  $\text{Bi}_4\text{Ti}_3\text{O}_{12}$  THIN FILMS ON SILICON SUBSTRATES

Topic #: DARPA90-107

Office:

ID #: 42466

ADVANCED FERROELECTRIC MEMORY DEVICES COMBINE THE FAST ACCESS TIME OF SEMICONDUCTOR RAMS WITH THE NONVOLATILITY OF MAGNETIC STORAGE TO CREATE AN IDEAL STORAGE MEDIUM. RECENT ATTEMPTS TO REALIZE SUCH DEVICES HAVE BEEN ONLY PARTIALLY SUCCESSFUL; LIMITED SWITCHING LIFETIMES CAUSED BY FATIGUE IN THE FERROELECTRIC MATERIALS IS STILL A SIGNIFICANT RELIABILITY CONCERN. TO REALIZE THE POTENTIAL OF FERROELECTRIC MEMORIES FOR ADVANCED APPLICATIONS, SUPERIOR MATERIALS, AND PROCESSING TECHNIQUES MUST BE APPLIED TO INCREASED PERFORMANCE RELIABILITY. THIS PROJECT WILL ASSESS THE FEASIBILITY OF A NOVEL APPROACH TO ACHIEVING DESIRED DEVICE PERFORMANCE BY UTILIZING THIN FILMS OF FERROELECTRIC BISMUTH TITANATE,  $\text{Bi}_4\text{Ti}_3\text{O}_{12}$ . THE FERROELECTRIC PROPERTIES OF BISMUTH TITANATE, EXTREMELY LOW AGING EFFECT, FAST SWITCHING CAPABILITY AND LOW COERCIVE FIELD, MAKE IT A VERY ATTRACTIVE MATERIAL FOR MEMORY APPLICATIONS. ADDITIONALLY, THE METHOD PROPOSED CAN ACHIEVE LOW TEMPERATURE FORMATION OF ORIENTED THIN FILMS OF BISMUTH TITANATE AND CAN BE INTEGRATED INTO A STANDARD SEMICONDUCTOR PROCESS FLOW. THE PHASE I RESEARCH WILL DEPOSIT BISMUTH TITANATE FILMS AND EXPERIMENTALLY DETERMINE THE FILM'S FERROELECTRIC CHARACTERISTICS AND RELATE THEM TO THE OBSERVED MICROSTRUCTURE AND DEPOSITION PROCESS VARIABLES. THE PROCESS WILL BE OPTIMIZED AND SCALED UP IN PHASE II/ ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - THIS PROCESSING TECHNIQUE WILL ENABLE COMMERCIAL SCALE PRODUCTION OF AN

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**ORIENTED FERROELECTRIC THIN FILMS ON SILICON FOR MICROELECTRONIC MEMORY APPLICATIONS. IT IS EXPECTED TO BE A COST-EFFECTIVE METHOD FOR PRODUCING SUCH FILMS IN LARGE DIAMETER SIZES FOR USE IN HIGH PERFORMANCE DEVICES FOR STRATEGIC AND COMMERCIAL APPLICATIONS. KEY WORDS - NONVOLATILE FERROELECTRIC MEMORIES, THIN FILM, BISMUTH TITANATE**

**PRINCETON RESOURCES INC**

**PO BOX 211**

**PRINCETON, NJ 08540**

**Program Manager: DR GEORGE TAYLOR**

**Contract #:**

**Title: IMPROVED FERROELECTRIC THIN FILMS FOR NONVOLATILE MEMORIES**

**Topic #: DARPA90-107**

**Office:**

**ID #: 42508**

**EXTENSIVE SWITCHING AND MEMORY STUDIES HAVE BEEN MADE IN THE PAST ON THICK FILMS (10 TO 200 MM) OF DOPED XXXX FERROELECTRIC CERAMINCS. PARTICULAR COMPOSITIONS WITHIN THIS CERAMIC FAMILY WERE FOUND TO BE GREATLY SUPERIOR TO COMPARABLE THICK FILMS OF PZT. THE XXXX FERROELECTRIC THICK FILMS HAD ENDURANCES TWO TO FIVE ORDERS OF MAGNITUDE GREATER, LOWER COERCIVE VOLTAGES, LOWER PIEZOELECTRIC ACTIVITY AND HIGHER SIGNAL TO NOISE RATIO THAN THE EQUIVALENT PZT THICK FILMS. THIN FILMS (500 TO 10,000A) OF SELECTED COMPOSITIONS FROM THE XXXX FAMILY WILL BE FABRICATED USING A NEW SOL GEL PROCESS BASED ON ACETATE PRECURSORS. THE ELECTRICAL PROPERTIES OF THESE XXXX FILMS WILL BE EVALUATED FOR THEIR APPLICATION AS NONVOLATILE MEMORIES. BASED ON THE THICK FILM DATA, THESE XXXX THIN FILMS ARE EXPECTED TO HAVE ENDURANCES OF BETWEEN 10 X13 AND 10 X16 READ/WRITE CYCLES. THIS IS TWO TO FIVE ORDERS THIN XXXX FILMS ARE ALSO EXPECTED TO HAVE LOWER COERCIVE VOLTAGES, LOWER PIEZOELECTRIC ACTIVITY AND HIGHER SIGNAL TO NOISE RATIOS THAN THE BEST THIN PZT FILMS. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - THE ANTICIPATED BENEFITS WOULD BE IMPROVED PERFORMANCE OF FERROELECTRIC NONVOLATILE I.C. MEMORIES. THE EXPECTED IMPROVEMENTS WOULD BE SUBSTANTIAL INCREASES OF ENDURANCE, SIGNAL TO NOISE RATIO AND SWITCHING SPEED. THESE IMPROVEMENTS ARE NECESSARY TO ALLOW FERROELECTRIC NONVOLATILE I.C. MEMORIES TO HAVE CAPACITIES OF UP TO AND IN EXCESS OF 1M BIT. SUCH MEMORIES HAVE MANY GENERAL PURPOSE AND SPECIALIZED GOVERNMENT AND COMMERCIAL APPLICATIONS. KEY WORDS - FERROELECTRIC, THIN FILM, ENDURANCE, PZT, SOL GEL, ACETATE PRECURSORS, NONVOLATILE MEMORIES**

**ATOM SCIENCES INC**

**114 RIDGEWAY CTR**

**OAK RIDGE, TN 37830**

**Program Manager: HEINRICH ARLINGHAUS**

**Contract #:**

**Title: QUANTITATIVE AND SENSITIVE PROFILING OF DOPANTS AND IMPURITIES IN COMPOUND SEMICONDUCTORS USING ...**

**Topic #: DARPA90-109**

**Office:**

**ID #: 42457**

**THE DEVELOPMENT OF AN ANALYTICAL TECHNIQUE HAVING HIGH DEPTH AND LATERAL RESOLUTION, VERY HIGH SENSITIVITY AND SELECTIVITY, VERY HIGH (> 10 X12) DYNAMIC RANGE, HIGH QUANTITATION ACCURACY, AND INDEPENDENCE FROM MATRIX EFFECTS ON SURFACES AND AT INTERFACES, IS CRITICAL IN MANY AREAS OF RESEARCH, DEVELOPMENT AND PRODUCTION, ESPECIALLY FOR THE ADVANCEMENT OF ELECTRONIC AND OPTOELECTRONIC MATERIALS. ALL COMMON PRESENT ANALYSIS TECHNIQUES SUCH AS SIMS, AES, RBS, DLTS, PHOTOLUMINESCENCE, ETC. HAVE SIGNIFICANT SHORTCOMINGS IN SENSITIVITY AND SOME IN RESOLUTION, QUANTITATION ACCURACY AND DYNAMIC RANGE. RESONANCE IONIZATION SPECTROSCOPY (RIS), BY UTILIZING STEPWISE EXCITATION AND IONIZATION OF ATOMS OF A PRESELECTED ELEMENT, ALLOWS VERY EFFICIENT DETECTION OF TRACE QUANTITIES OF ATOMS WITHOUT INTERFERENCE FROM THE MAJOR CONSTITUENTS OF THE SAMPLE. BY UTILIZING RIS ON THE NEUTRAL ATOMS REMOVED FROM THE SAMPLE DURING ANALYSIS, WITH FOR EXAMPLE, A SPUTTERING BEAM, IT**

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IS POSSIBLE TO SIGNIFICANTLY INCREASE SENSITIVITY, QUANTITATION, ACCURACY AND DYNAMIC RANGE. IN PHASE I WE WILL DEMONSTRATE THE CAPABILITY OF SIRIS (SPUTTER-INITIATED RIS) TO QUANTITATE WITH HIGH ACCURACY AND DEPTH RESOLUTION DOPANT AND IMPURITY CONCENTRATIONS IN SEMICONDUCTOR DEVICES AT THE  $10 \times 14$  TO  $10 \times 20$  LEVEL. IN PHASE II, THE PROTOTYPE FOR A SIGNIFICANTLY ADVANCED COMPOUND SEMICONDUCTOR PROFILING INSTRUMENT WILL BE CONSTRUCTED. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - A NEW ANALYSIS TECHNIQUE FOR SURFACE AND INTERFACE STRUCTURES OF MATERIALS, WITH HIGH QUANTITATION ACCURACY, INTERFACE-FREE ULTRA-TRACE SENSITIVITY, HIGH DYNAMIC RANGE, AND HIGH LATERAL AND DEPTH RESOLUTION, WILL LEAD TO IMPROVED ELECTRONIC AND ELECTRO-OPTICAL DEVICES. SIMILAR TECHNIQUES WILL FIND APPLICATION IN GEOLOGICAL EXPLORATION, BIOLOGICAL SCIENCES AND MATERIAL CHARACTERIZATION IN GENERAL, AND LEAD TO A SUBSTANTIAL MARKET FOR INSTRUMENT SALES.

PARK SCIENTIFIC INSTRUMENTS CORP  
476 ELLIS ST

MOUNTAIN VIEW, CA 94043

Program Manager: IAN SMITH

Contract #:

Title: 3-DIMENSIONAL DOPANT PROFILING USING SCANNING CAPACITANCE MICROSCOPY

Topic #: DARPA90-109

Office:

ID #: 42504

EXISTING TECHNIQUES FOR NON-DESTRUCTIVE SEMICONDUCTOR DOPANT PROFILING ARE LIMITED EITHER IN SPATIAL RESOLUTION, SENSITIVITY OR ACCURACY. THE OBJECT OF THIS PROGRAM IS TO THOROUGHLY CHARACTERIZE THE CAPABILITIES AND LIMITATIONS OF SCANNING CAPACITANCE MICROSCOPY FOR TRUE THREE-DIMENSIONAL SEMICONDUCTOR DOPANT PROFILING WITH SUB-MICRON SPATIAL RESOLUTION. WE AIM TO DEFINE DESIGN PARAMETERS AND BUILD PROTOTYPE HARDWARE FOR A COMMERCIAL RESEARCH INSTRUMENT BASED ON PARK SCIENTIFIC INSTRUMENTS' CURRENT RANGE OF SCANNING TUNNELING MICROSCOPES; THIS WILL ENABLE MORE WIDESPREAD EVALUATION OF THE TECHNIQUE BY PROCESS ENGINEERS ON THEIR OWN PROCESSES, USING DEBUGGED HARDWARE THAT HAS ALREADY BEEN OPTIMISED FOR THE APPLICATION. WE PROPOSE TO EVALUATE PERFORMANCE BOTH ON SIMPLE TEST STRUCTURES AS WELL AS ON TYPICAL PRODUCTION SEMICONDUCTOR DEVICES AND TO COMPARE RESULTS WITH ALTERNATIVE DESTRUCTIVE AND NON-DESTRUCTIVE MEASUREMENT TECHNIQUES AS WELL AS WITH THEORY. IN THIS EFFORT WE PLAN TO COLLABORATE EXTENSIVELY WITH LOCAL PROCESS ENGINEERS, WHO WILL PROVIDE TEST SAMPLES. WE WILL INVESTIGATE HOW ESTABLISHED CAPACITANCE FEEDBACK DEPTH PROFILING TECHNIQUES COULD BE COMBINED WITH THE SCANNING CAPACITANCE MICROSCOPE TO FURTHER EXTEND THE TECHNIQUE. THESE PHASE I ACTIVITIES WOULD PAVE THE WAY FOR A PHASE II PROGRAM TO DEVELOP ON-LINE AUTOMATED INSTRUMENTATION FOR SEMICONDUCTOR PROCESS CONTROL. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - A) DEVELOPMENT OF 3-DIMENSIONAL DOPANT PROFILING WITH SUB-MICRON RESOLUTION; B) AVAILABILITY OF COMMERCIAL RESEARCH HARDWARE FOR THOROUGH CHARACTERIZATION OF THE TECHNIQUE; C) POTENTIAL USE OF THE TECHNIQUE BY THE SEMICONDUCTOR INDUSTRY TO IMPROVE DEVICE AND PROCESS PERFORMANCE AND YIELD. KEY WORDS - DOPANT PROFILING, 3-DIMENSIONAL, SUB-MICRON RESOLUTION, NON-DESTRUCTIVE, SEMICONDUCTOR FABRICATION, PROCESS CONTROL

QUANTUM MAGNETICS INC  
11578 SORRENTO VALLEY RD - #30  
SAN DIEGO, CA 92121

Program Manager: DAVID N SHYKIND

Contract #:

Title: HIGH RESOLUTION PROFILING OF COMPOUND SEMICONDUCTORS BY OPTICALLY DETECTED NUCLEAR MAGNETIC RESONANCE

Topic #: DARPA90-109

Office: DSO

ID #: 50330

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A FUNDAMENTAL PROGRAM IN SEMICONDUCTOR DEVICE PHYSICS IS THE LOCALIZATION AND CHEMICAL IDENTIFICATION OF DEFECTS IMPORTANT TO ELECTRICAL OR OPTICAL PROPERTIES. NUCLEAR MAGNETIC RESONANCE (NMR) SPECTROSCOPY IS A PREMIER TOOL FOR STUDYING THESE CHARACTERISTICS. IN ITS USUAL FORM OF DETECTION, HOWEVER, NMR LACKS THE SENSITIVITY NEEDED TO DETECT DEFECTS AT THE LOW CONCENTRATIONS PRESENT IN DEVICE-QUALITY MATERIALS. USING A NOVEL COMBINATION OF OPTICAL AND NMR SPECTROSCOPIES IT IS POSSIBLE TO ENHANCE THE SENSITIVITY OF NMR MANY ORDERS OF MAGNITUDE BEYOND WHAT IS OBTAINABLE BY CONVENTIONAL DETECTION. THIS INCREASED SENSITIVITY WILL ALLOW US TO APPLY THE CHEMICAL SPECIFICITY OF NMR TO SPATIAL LOCALIZATION OF DEFECT SITES IN BULK MATERIAL, SINGLE CRYSTAL SURFACES, AND SEMICONDUCTOR INTERFACES. SPATIAL RESOLUTION FROM 1 nm TO MACROSCOPIC LENGTH SCALES IS ANTICIPATED. KEY OBJECTIVES OF THIS PHASE I PROJECT ARE THE DESIGN AND CONSTRUCTION OF A NOVEL FIELD-CYCLING OPTICALLY ACCESSIBLE CRYOSTAT, THE EXPERIMENTAL DETERMINATION OF THE MINIMUM USABLE OPTICAL VOLUME, THE QUANTIFICATION OF METHODS FOR NANOMETER-SCALE IMAGING WITHIN THE OPTICAL VOLUME, AND THE DESIGN OF A COMMERCIALIZABLE INSTRUMENT.

RECOGNITION TECHNOLOGY INC  
160 E MAIN ST - STE 3  
WESTBOROUGH, MA 01581  
Program Manager: THOMAS BUSHMAN  
Contract #:

Title: DEMONSTRATION OF CAPABILITY ACCURACY AND VERSATILITY OF A TECHNIQUE FOR HIGH RESOLUTION DOPANT ...

Topic #: DARPA90-109

Office:

ID #: 42511

RECOGNITION TECHNOLOGY, UNDER THE DIRECTION OF THOMAS BUSHMAN - PRINCIPAL INVESTIGATOR, WITH MASSACHUSETTS INSTITUTE OF TECHNOLOGY CONSULTANTS, DR. AUGUST WITT AND DR. DOUGLAS CARLSON, PROPOSE THE ESTABLISHMENT OF NIR ABSORPTION AND COMPLEMENTARY PHOTOLUMINESCENCE IMAGING CAPABILITY FOR THE NEAR REAL TIME, NONDESTRUCTIVE DOPANT CHARACTERIZATION OF ELEMENTARY AND COMPOUND SEMICONDUCTOR WAFERS IN A FABLINE ENVIRONMENT. USING MICRO-SCALE AND COMPLEMENTARY MACRO-SCALE IMAGING ANALYSES BASED ON QUANTIFIABLE NIR ABSORPTION AND PL, IN COMBINATION WITH ADVANCED CONTRAST ENHANCEMENT, IT IS ANTICIPATED THAT DOPANT CONCENTRATION LEVELS RANGING FROM  $10 \times 10^{15}$  TO THE MID  $10 \times 10^{15}/\text{cm}^3$  CAN BE QUANTITATIVELY ANALYZED WITH THE REQUIRED PRECISION WITH AT LEAST 10 NANOMETER DEPTH RESOLUTION. THE NIR IMAGING AND ANALYSIS APPROACH TO BE DEVELOPED WILL PERMIT IN ADDITION THE DETECTION OF DISLOCATION NETWORKS, PRECIPITATES, AND LATTICE STRAIN; IT IS TO BE APPLIED TO DOUBLE SIDED POLISHED WAFERS, TO EPITAXIAL LAYERS AND TO ION-IMPLANT SYSTEM. THE "NEAR REAL TIME NATURE" OF THE ANALYSIS MAKES IT SUITABLE FOR QUALITY CONTROL AND THE RELATED IMAGING PROCESS WILL PROVIDE FOR A READILY RETRIEVABLE DEFECT RECORD FOR EACH WAFER ANALYZED. THE COSTS FOR THE REQUIRED HARDWARE ARE EXPECTED TO BE A FRACTION ONLY OF THE COSTS ASSOCIATED WITH THE ACQUISITION OF INSTRUMENTATION FOR CONVENTIONAL ELECTRICAL CHARACTERIZATION. THE OUTSTANDING FEATURES OF THE PROPOSED OPTICAL CHARACTERIZATION TECHNIQUE IS ITS EXTREME SPEED, ITS SUITABILITY FOR PROCESS AUTOMATION AND ITS DIVERSE APPLICABILITY. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - THE SYSTEM, AFTER DEVELOPMENT BY RTI, WILL HAVE COMMERCIAL APPLICATION FOR: PROCESS DEVELOPMENT, QUALITY CONTROL OF WAFERS, ESTABLISHMENT OF GROWTH CONTROL OBJECTIVES; AND ACHIEVEMENT OF WAFERS WITH SUPERIOR QUALITY RELATED TO FABLINE CHARACTERISTICS. POTENTIAL COMMERCIAL

FLUOROCHEM INC  
680 S AYON AVE  
AZUSA, CA 91702  
Program Manager: THOMAS ARCHIBALD

SMALL BUSINESS INNOVATION RESEARCH PROGRAM - PHASE I  
DARPA Solicitation 90.2

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Contract #:

Title: SYTHESIS OF POLYNITRAZADAMANTANES

Topic #: DARPA90-110

Office:

ID #: 42474

SIGNIFICANT IMPROVEMENT IN PERFORMANCE IS REALIZED BY INTRODUCTION OF THE NITRAZA GROUP INTO CAGED MOLECULES. CONDENSATION REACTIONS WILL BE EXPLORED AS A ROUTE TO INEXPENSIVE, HIGH ENERGY POLYNITRAZA CAGE COMPOUNDS WHICH WILL EXHIBIT HIGHER DENSITY AND STABILITY THAN THAT OF HMX. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - THE AVAILABILITY OF NITRAZAADAMANTANE DERIVATIVES WOULD ENABLE THE DEVELOPMENT AND TESTING OF EXPLOSIVES AND PROPELLANTS WITH IMPROVED PERFORMANCE. KEY WORDS - SYNTHESIS, AZAADAMANTANES, NITRAMINES, CONDENSATION REACTIONS

GEO-CENTERS INC

7 WELLS AVE

NEWTON CENTRE, MA 02159

Program Manager: DR GERARD DOYLE

Contract #:

Title: DEVELOPMENT OF NEW ENERGETIC MATERIALS

Topic #: DARPA90-110

Office:

ID #: 42484

IN ORDER TO ENHANCE THE PERFORMANCE OF CONVENTIONAL WEAPONS SYSTEMS, THERE IS A NEED FOR PROPELLANTS AND EXPLOSIVES WHICH ARE SIGNIFICANTLY MORE POWERFUL AND LESS SENSITIVE THAN THOSE CURRENTLY AVAILABLE. BECAUSE OF THE HIGH DENSITIES AND HIGH STRAIN ENERGIES CHARACTERISTIC OF SMALL CAGE MOLECULES, POLYNITRO CAGE COMPOUNDS ARE PRIME CANDIDATES FOR NEW POWERFUL EXPLOSIVES. PARTICULARLY INTERESTING ARE COMPOUNDS CONTAINING GEMINAL DINITRO GROUPS WHICH HAVE BEEN FOUND TO BE QUITE INSENSITIVE. A NUMBER OF POLYNITRO CAGE COMPOUNDS INCLUDING BOTH C-NITRO AND N-NITRO COMPOUNDS HAVE BEEN IDENTIFIED AS POTENTIAL NEW, INSENSITIVE, HIGH EXPLOSIVES. COMPOUNDS BASED ON THE ADAMANTANE, SECOCUBANE AND DIASTERANE SKELETONS HAVE BEEN PROPOSED FOR FURTHER STUDY. CALCULATIONS TO DETERMINE DENSITIES, HEATS OF FORMATION, AND DETONATION VELOCITY AND PRESSURE WILL BE CARRIED OUT ON THESE COMPOUNDS TO EVALUATE WHICH OF THE MATERIALS SHOULD BE PURSUED IN A SYNTHETIC PROGRAM. SYNTHETIC ROUTES FOR THE MOST LIKELY CANDIDATES WILL BE DEVELOPED AND KEY SYNTHETIC STEPS WILL BE PERFORMED ON THE ACTUAL MOLECULES OR ON MODEL SYSTEMS IN THE PHASE I EFFORT. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - DATA OBTAINED FROM THIS RESEARCH EFFORT WILL BE USED AS A GUIDE FOR THE DEVELOPMENT OF NEW ENERGETIC MATERIALS WHICH ARE BOTH POWERFUL AND INSENSITIVE. THESE MATERIALS WILL FIND APPLICATION IN BOTH EXPLOSIVES AND PROPELLANTS WHICH WILL SIGNIFICANTLY INCREASE THE PERFORMANCE CHARACTERISTICS OF NEW CONVENTIONAL WEAPON SYSTEMS. THE NEW CAGE COMPOUNDS DEVELOPED IN THIS PROGRAM WILL ALSO HAVE APPLICATION IN OTHER AREAS OF ORGANIC CHEMISTRY, PARTICULARLY IN PHARMACEUTICALS. KEY WORDS - HIGH DENSITY, POLYNITROPOLYCYCLES, NITRAMINES, ADAMANTANES, INSENSITIVE, GEMINAL DINITRO, SECOCUBANES, DIASTERANES

FLUOROCHEM INC

680 S AYON AVE

AZUSA, CA 91702

Program Manager: ASLAM MALIK

Contract #:

Title: ADVANCED FOULING CONTROL COATINGS

Topic #: DARPA90-111

Office:

ID #: 42475

BARNACLE REMOVAL ON SHIPS ENTAILS SIGNIFICANT COST TO THE NAVY, AND CURRENT ANTI-FOULING PAINTS ENTAIL ENVIRONMENTAL PROBLEMS. FLUOROCHEM HAS DEVELOPED A FLUORINATED

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POLYURETHANE WITH BARNACLE-RESISTANT PROPERTIES. IN THE PROPOSED PROGRAM, RELATED POLYMERS CONTAINING DISILOXANE SEGMENTS WILL BE PREPARED TO INCREASE CHAIN FLEXIBILITY AND PROVIDE IMPROVED LOW-TEMPERATURE PROPERTIES. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - IMPROVE ANTI-FOULING COATINGS WILL IMPROVE OPERATING EFFICIENCY OF BOTH NAVAL AND COMMERCIAL SHIPPING. ENVIRONMENTAL PROBLEMS OF TIN/COPPER BASED PAINTS WOULD BE AVOIDED. KEY WORDS - FLUOROPOLYMERS, SILOXANES, ANTI-FOULING COATINGS

GUMBS ASSOCS INC

11 HARTS LN

EAST BRUNSWICK, NJ 08816

Program Manager: DR RONALD W GUMBS

Contract #:

Title: ANTIFOULING COATINGS BASED ON COPOLYMERS OF SILICONES AND FLUOROPOLYMERS

Topic #: DARPA90-111

Office: DSO

ID #: 50327

THIS PROPOSAL OUTLINES A RESEARCH AND DEVELOPMENT PROGRAM TO SYNTHESIZE, CHARACTERIZE AND EVALUATE COPOLYMERS OF SILICONES AND FLUOROPOLYMERS HAVING THE RELEASE PROPERTIES OF THE SILICONES, BUT WITHOUT THEIR LOW TOUGHNESS. PERFLUORINATED DICARBOXYLIC ACIDS WILL BE REACTED WITH AMINO AND HYDROXYL FUNCTIONAL SILICONES AND FLUOROSILICONES TO FORM POLYAMIDES AND POLYESTERS. IN ADDITION, THE 6F DIANHYDRIDE WILL BE REACTED WITH AMINO FUNCTIONAL SILICONES AND FLUOROSILICONES TO YIELD SILICON POLYIMIDES. THE CONCENTRATION OF BOTH THE SILICONE AND THE PERFLUORINATED GROUPS IN THE COPOLYMER CAN BE EASILY VARIED AND STRONG ADHESION OF THE COPOLYMER TO THE SUBSTRATE WILL BE AN IMPORTANT OBJECTIVE DURING PHASE I. THE BEST COPOLYMERS WILL BE EVALUATED IN FOULING TESTS ON SMALL PANELS AND THE FOULING BEHAVIOR WILL BE CORRELATED WITH SURFACE PROPERTIES BY CARRYING OUT MORPHOLOGICAL, CHEMICAL AND PHYSICAL SURFACE ANALYSES ON SELECTED SAMPLES. THE SYNTHESIS WILL BE SCALED-UP DURING PHASE II TOWARD COMMERCIAL VOLUME AND HULLS WILL BE COATED AND EVALUATED AFTER LONG TERM TESTS HAVE BEEN CARRIED OUT IN THE OCEAN.

CERACON INC

1101 N MARKET BLVD - STE 9

SACRAMENTO, CA 95834

Program Manager: DR RAMAS RAMAN

Contract #:

Title: A NOVEL PROCESSING-MICROSTRUCTURAL DESIGN APPROACH TO FORM RELIABLE CERAMIC MATRIX COMPOSITES

Topic #: DARPA90-112

Office:

ID #: 42461

THE CERAMIC-REINFORCED CERAMIC-MATRIX COMPOSITES (CMCS) OFFER SIGNIFICANT ADVANTAGES OF FRACTURE TOUGHNESS AND HIGH TEMPERATURE STRENGTH OVER THE MONOLITHIC CERAMICS. HOWEVER, MICROSTRUCTURAL DESIGN COUPLED WITH CONTROLLED PROCESSING IS REQUIRED TO FORM RELIABLE MATERIALS THAT CAN BE SAFELY APPLIED FOR INDUSTRIAL APPLICATIONS. A NOVEL PROCESSING APPROACH IS PROPOSED FOR FABRICATING DENSE, NEAR-NET SHAPE SiC WHISKER REINFORCED Si<sub>3</sub>N<sub>4</sub> COMPOSITES. IT INVOLVES REDUCING FLAWS ORIGINATING FROM PROCESSING AND SIMULTANEOUSLY INTRODUCING TOUGHENING MECHANISMS. HIGH PRESSURE, QUASI-ISOSTATIC LOWER TEMPERATURE CONSOLIDATION WILL BE EMPLOYED TO FORM A BSi<sub>3</sub>N<sub>4</sub> MATRIX WITH TUNGSTEN COATED SiC WHISKERS TO THEORETICAL DENSITIES WHILE MAINTAINING A FINE MATRIX GRAIN SIZE, MINIMIZING INTERFACIAL REACTIONS AND OBTAINING OPTIMIZED DEBONDING. SUCCESSFUL COMPLETION OF PHASE I WILL RESULT IN DEMONSTRATION OF A PROCESS FOR FABRICATING RELIABLE CMCS WITH PROPERTIES SUPERIOR TO THE STATE-OF-THE-ART. PHASE II WILL INTEGRATE THE WHISKERS IN 2-D COUPLED WITH FIBER ROUGHENING IN THE 3-D STRUCTURE. PHASE II WILL DEMONSTRATE NEAR-NET SHAPE CAPABILITY AND FABRICATION OF A STRUCTURAL PROTOTYPE. PHASE III WILL SCALE UP THIS PROCESS ESTABLISHING A MANUFACTURING CAPABILITY FOR FORMING RELIABLE, HIGH TOUGHNESS, HIGH STRENGTH, CERAMIC



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MATRIX COMPOSITES. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - THE DEVELOPMENT OF THIS PROPOSED APPROACH TO FORM RELIABLE CERAMIC-MATRIX COMPOSITES WILL ENABLE ACCELERATED APPLICATION OF CERAMICS IN HIGH TEMPERATURE APPLICATIONS IN DOD. SIGNIFICANT ACTIVITIES IN THE USE OF CERAMIC MATERIALS IN THE AIR FORCE, ARMY, AND NAVY WILL BENEFIT. COMMERCIAL SPIN-OFFS ARE LIKELY IN ADVANCED CUTTING TOOLS, TURBOEHOLOGERS, BEARINGS AND WEAR PARTS.

CRYSTALLUME

125 CONSTITUTION DR  
MENLO PARK, CA 94025

Program Manager: DR MICHAEL PINNEO

Contract #:

Title: DIAMOND COMPOSITE CERAMICS

Topic #: DARPA90-112

Office:

ID #: 42467

RECENT EXPERIMENTAL EVIDENCE DEMONSTRATES FEASIBILITY OF MANUFACTURING NEW CLASSES OF CERAMICS AND CERMETS CONSISTING IN WHOLE OR IN PART OF DIAMOND. IT IS LIKELY THAT THESE MATERIALS WILL INCLUDE CERAMICS AND CERMETS REINFORCED WITH DIAMOND FIBERS. THESE NEW COMPOSITES ARE EXPECTED TO EXHIBIT AN UNPRECEDENTED RANGE OF PHYSICAL PROPERTIES, INCLUDING SUPERIOR THERMAL CONDUCTIVITY, EXCELLENT RESISTANCE TO THERMAL \_\_\_\_\_ EXTREME HARDNESS, CONTROLLABLE ELECTRICAL RESISTIVITY, AND OTHER PROPERTIES UNIQUE TO DIAMOND. MANUFACTURE OF THESE CERAMICS EMPLOYS PLASMA-ENHANCED CHEMICAL VAPOR DIAMOND DEPOSITION TECHNOLOGY RECENTLY DEVELOPED WITH GREAT SUCCESS FOR SYNTHESIS OF DIAMOND THIN FILMS. THE PROPOSED PHASE I WORK WILL DEFINE PROCESSES FOR MAKING DIAMOND COMPOSITE CERAMICS, PREPARE DIAMOND COMPOSITE CERAMICS BOTH WITH AND WITHOUT REINFORCING WHISKERS, AND WILL CHARACTERIZE THESE MATERIALS FOR COMPOSITION, MICROSTRUCTURE, AND FRACTURE STRENGTH. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - THE FIELDS OF APPLICATIONS FOR DIAMOND COMPOSITE CERAMICS ARE EXTREMELY VARIED. IN THE FEDERAL AREAS OF INTEREST, CRYSTALLUME EXPECTED THESE MATERIALS TO FIND USE IN ADVANCED ARMOR AND KINETIC PENETRATORS, PRECISION GUIDANCE STRUCTURES, AND AIRFRAME AND MISSILE STRUCTURES WITH STEALTH CHARACTERISTICS. A MAJOR ELECTRONIC USE WILL ARISE IN PACKAGING OF THERMALLY-LIMITED ELECTRONIC DEVICES SUCH AS MULTICHIP MODULES (MCMs). WITH DECLINING PRODUCTION COSTS, LARGE-VOLUME APPLICATIONS SUCH AS GUN BARREL LINERS SHOULD COME WITHIN PRACTICAL REACH OF THE TECHNOLOGY. COMMERCIAL APPLICATIONS OF THESE MATERIALS WILL FIRST INCLUDE ELECTRONIC PACKAGING AND SLIDING WEAR SURFACE APPLICATIONS SUCH AS PRECISION MACHINE TOOL BEDS AND WAYS. INTERMEDIATE APPLICATIONS INCLUDE NEW TYPES OF CUTTING TOOLS, WITH LONGER-TERM USES INCLUDING TURBINE BLADES FOR HIGH-TEMPERATURE, ENHANCED FUEL EFFICIENCY TURBINES.

GORHAM ADVANCED MATERIALS INSTITUTE

211 MOSHER RD

SOUTH WINDHAM, ME 04062

Program Manager: ANDREW NYCE

Contract #:

Title: COMBINED SELF PROPAGATING HIGH TEMPERATURE SYNTHESIS AND IN SITU HOT ISOSTATIC PRESSING OF  $TiB(2)+AlN$  AND  $TiB(2)AlN+SiC(w)$

Topic #: DARPA90-112

Office: DSO

ID #: 50326

THIS PROPOSAL OUTLINES THE INITIAL PHASE OF AN R&D PROGRAM, THE OVERALL OBJECTIVE OF WHICH IS TO DETERMINE THE FEASIBILITY OF A COMBINED PROCESS OF SELF PROPAGATING HIGH TEMPERATURE SYNTHESIS (SHS) AND IN SITU HOT ISOSTATIC PRESSING (HIP) AS A MEANS FOR THE COST-EFFECTIVE PRODUCTION OF NEAR NET SHAPE  $TiB(2)+AlN$  AND  $TiB(2)+AlN+SiC(w)$  (SILICON CARBIDE WHISKERS) COMPOSITES WITH SUPERIOR MECHANICAL PROPERTIES. IN THE PROPOSED RESEARCH PROGRAM THE

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PERFORMANCE ADVANTAGE OF HIP/SHS  $TiB(2) + AlN$  AND  $TiB(2) + AlN + SiC(w)$  COMPOSITES OVER UNIAXIALLY HOT PRESSED  $TiB(2) + AlN$  WILL BE INVESTIGATED. SEVERAL APPROACHES WILL BE EXPLORED, INCLUDING BOTH HIGH TEMPERATURE CONTAINERIZED AND CONTAINERLESS HIP'ING COMBINED WITH SHS.

MSNW INC  
PO BOX 865  
SAN MARCOS, CA 92069  
Program Manager: DR E McCORMICK  
Contract #:

Title: FABRICATION OF NEAR NET SHAPE  $SiC/SiC$  COMPOSITES BY SILICON MELT INFILTRATION  
Topic #: DARPA90-112                      Office:                      ID #: 42498

THE OVERALL OBJECT OF THIS PROGRAM IS TO DEVELOP AN ECONOMIC PROCESS FOR THE NEAR NET SHAPE FABRICATION OF  $SiC/SiC$  CERAMIC COMPOSITES BY LIQUID SILICON INFILTRATION OF POROUS  $SiC$  FIBER/CARBON MATRIX PERFORMS. THE PRIMARY OBJECTIVE OF THE PHASE I EFFORT IS TO DEMONSTRATE THAT A SILICON MELT INFILTRATION PROCESS CAN BE USED TO FABRICATE A DENSE COMPOSITE WITH CONTROLLED QUANTITIES OF FREE SILICON OR FREE CARBON IN THE MATRIX. A SECOND OBJECTIVE IS TO DEMONSTRATE A FIBER COATING SYSTEM THAT WILL GIVE THE COMPOSITE THE REQUIRED TOUGHNESS.  $SiC$  FIBER REINFORCED, PHENOLIC RESIN MATRIX, 2D LAMINATE PREFORMS WILL BE PREPARED BY CONVENTIONAL RESIN COMPOSITE TECHNOLOGY. THE FIBERS WILL HAVE A CARBON COATING TO PROTECT THEM AND TO PROMOTE WETTING BY THE INFILTRANT. VARIOUS MATRIX RESINS WILL BE USED SO THAT PYROLYSIS WILL YIELD POROUS PREFORMS WITH OPEN POROSITIES BETWEEN 15% AND 30%. THE PYROLYZED PREFORMS WILL BE MELT INFILTRATED WITH LIQUID SILICON TO CONVERT THE MATRIX CARBON TO  $SiC$ . THE FIBER COATING EFFORT WILL FOCUS ON THE USE OF BN OR CARBON AS THE WEAK FIBER/MATRIX INTERFACE AND  $Bn$  OR  $SiO_2$  AS THE DIFFUSION BARRIER. BN AND CARBON FIBER COATINGS WILL BE APPLIED BY CHEMICAL VAPOR DEPOSITION (CVD).  $SiO_2$  DIFFUSION BARRIERS WILL BE FORMED IN SITU BY OXIDATION OF AN  $SiC$  OUTER FIBER COATING. THIS PROGRAM WILL DEMONSTRATE AN ECONOMIC NEAR NET SHAPE PROCESS FOR THE FABRICATION OF  $SiC/SiC$  CERAMIC COMPOSITES. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - HIGH TEMPERATURE  $SiC/SiC$  COMPOSITES WOULD ALSO FIND USE IN A VARIETY OF INDUSTRIAL AND POWER SYSTEM APPLICATIONS, INCLUDING HEAT EXCHANGERS, GAS-FIRED RADIANT HEATERS, AND INDUSTRIAL AND VEHICULAR TURBINE ENGINES. KEY WORDS - CERAMIC COMPOSITE, SILICON CARBIDE

ULTRAMET  
12173 MONTAGUE ST  
PACOIMA, CA 91331  
Program Manager: ANDREW SHERMAN  
Contract #:

Title: FFTG-P  $Si_3N_4$  INFILTRATION FOR IMPROVED CERAMIC COMPOSITES  
Topic #: DARPA90-112                      Office:                      ID #: 42523

IN RESPONSE TO THE NEED FOR IMPROVED ENGINEERED MATERIALS FOR ADVANCED ELEVATED TEMPERATURE APPLICATIONS, ULTRAMET PROPOSES TO APPLY THE EXTENSIVE COMPOSITE PROCESSING EXPERIENCE, KNOWLEDGE BASE, AND UNDERSTANDING ACQUIRED IN SEVERAL CERAMIC AND COMPOSITE DEVELOPMENT PROGRAMS TO IMPROVING THE STATE-OF- THE-ART IN CHEMICAL VAPOR INFILTRATION (CVI) PROCESSING. SPECIFICALLY, ULTRAMET INTENDS TO COMBINE THE FORCED-FLOW THERMAL GRADIENT AND PULSE TECHNIQUES OF INFILTRATION, DIRECTLY RESULTING IN HIGHER QUALITY, MORE ECONOMICAL SILICON NITRIDE ( $Si_3N_4$ ) COMPOSITES FOR USE IN IHPTET PHASE II AND III ENGINES. THE PROPOSED APPROACH HAS THE POTENTIAL TO SOLVE THE RECURRING DIFFICULTY OF MICROPOROSITY BETWEEN FIBERS DUE TO INADEQUATE INFILTRATION, ELIMINATE THE SUBSTANTIAL PERMEABILITY OCCURRING IN CURRENT STATE-OF-THE-ART MATERIALS, AND IMPROVE THE ECONOMICS OF COMPOSITE PROCESSING VIA VASTLY REDUCED PROCESSING TIMES. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL

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APPLICATIONS - THE DEVELOPMENT OF A DAMAGE-TOLERANT  $\text{Si}_3\text{N}_4$  CERAMIC COMPOSITE WOULD PROVIDE A CRITICAL MILESTONE IN THE DEVELOPMENT OF HIGH-PERFORMANCE MATERIALS FOR A WIDE VARIETY OF AEROSPACE STRUCTURAL APPLICATIONS. THE USE OF ADVANCED CERAMIC COMPOSITES IN FUTURE PROPULSION DESIGNS WOULD ALSO PROVIDE SUBSTANTIAL EFFICIENCY PAYOFFS IN TERMS OF OPERATING TEMPERATURE, FUEL CONSUMPTION, AND WEIGHT. KEY WORDS - CERAMIC COMPOSITES, PULSED, SILICON NITRIDE ( $\text{Si}_3\text{N}_4$ ), COMPOSITE PROCESSING, FORCED-FLOW, CHEMICAL VAPOR INFILTRATION (CVI), THERMAL GRADIENT.

FOSTER-MILLER INC  
350 SECOND AVE  
WALTHAM, MA 02154

Program Manager: DR ROBERT KOVAR

Contract #:

Title: HIGH COMPRESSIVE STRENGTH ORGANIC COMPOSITES

Topic #: DARPA90-113

Office:

ID #: 43465

COMPOSITES BASED UPON ORGANIC POLYMER AND CARBON FIBERS AND THERMOPLASTIC AND THERMOSET POLYMER MATRICES CURRENTLY SHOW UNSATISFACTORY COMPRESSIVE STRENGTHS, ONLY ONE-HALF TO ONE-TENTH OF THE EXPECTED AND THEORETICALLY POSSIBLE VALUES. FOSTER-MILLER PROPOSES TO ADDRESS ONE MAJOR CAUSE OF THIS PROBLEM; NAMELY, INADEQUATE INTERFACIAL INTERACTION, BY MODIFYING THE FIBER/MATRIX INTERFACE. DURING THIS PHASE I PROGRAM, WE WILL DEMONSTRATE A PRACTICAL ROUTE TO IMPROVING THE COMPRESSIVE STRENGTH OF ORGANIC COMPOSITES BY MORE THAN TWOFOLD OVER CURRENT VALUES. WE WILL EVALUATE THREE PROPRIETARY METHODS FOR INTERFACE-MODIFICATION OF PBO AND CARBON FIBER/PEEK THERMOPLASTIC MATRIX COMPOSITES. THEY ARE: CHEMICAL VAPOR DEPOSITION OF TAILORED POLYMER SIZINGS, COATING OF AQUEOUS-BASED POLYMERIC SIZINGS, AND ORGANOMETALLIC SURFACE MODIFICATION. ONE CANDIDATE WILL BE SELECTED ON THE BASIS OF ITS POTENTIAL FOR IMPROVING THE COMPRESSIVE STRENGTH, EASE OF APPLICATION AND COST, THEN USED TO MODIFY THE INTERFACES OF PBO AND CARBON FIBERS IN PEEK MATRIX COMPOSITES. INTERFACE-MODIFICATION WILL DRAMATICALLY IMPROVE THE COMPRESSIVE STRENGTH OF ORGANIC COMPOSITES BY INCREASING THEIR FIBER/MATRIX ADHESION. PHASE I WILL DEMONSTRATE THE FEASIBILITY OF PRODUCING INTERFACE-MODIFIED PBO AND CARBON FIBER/PEEK COMPOSITES THAT EXHIBIT COMPRESSIVE STRENGTHS HIGHER THAN 200 Ksi. IN PHASE II, WE WILL DEVELOP AND APPLY THE PROCESS MORE GENERALLY TO PRODUCE INTERFACE-MODIFIED FIBER COMPOSITES WITH IMPROVED COMPRESSIVE STRENGTH.

FOSTER-MILLER INC  
350 SECOND AVE  
WALTHAM, MA 02154

Program Manager: RAMAKRISHNA IVER

Contract #:

Title: DENDRITES THE SOLUTION TO IMPROVE COMPRESSIVE BEHAVIOR OF COMPOSITE STRUCTURES

Topic #: DARPA90-113

Office:

ID #: 52884

COMPOSITES HAVE ESTABLISHED THEIR ADVANTAGES FOR HIGH PERFORMANCE AND WEIGHT REDUCTION, PARTICULARLY IN TENSION-LOADED STRUCTURES. THESE MATERIALS POSSESS HIGH STIFFNESSES AND TENSILE STRENGTHS COMBINED WITH LOW DENSITY, AND THEY HAVE BECOME THE MATERIAL OF CHOICE IN NUMEROUS HIGH PERFORMANCE APPLICATIONS. THE SAME CANNOT BE SAID FOR COMPRESSIVE PROPERTIES OF THESE MATERIALS, WHICH ARE OFTEN MUCH LOWER THAN THEIR TENSILE COUNTERPARTS. THIS OFTEN RESULTS IN OVERDESIGNING FOR COMPRESSION, WITH CORRESPONDINGLY HIGHER WEIGHT. REDUCED COMPRESSION BEHAVIOR IN SUCH MATERIALS IS ATTRIBUTABLE TO MICROFIBRILLAR BUCKLING AND KINKING PHENOMENA WHICH MAYBE ASSOCIATED WITH THE FIBER ITSELF, THE MATRIX, OR THE INTERFACE BETWEEN THE TWO. IN ORDER FOR COMPOSITES SUBJECTED TO BOTH TENSILE AND COMPRESSION TO BE OPTIMALLY DESIGNED, THESE PROPERTIES MUST BE INCREASED.

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THIS PROPOSAL PRESENTS AN INNOVATIVE AND EXCITING APPROACH TO IMPROVING THE PROPERTIES OF THESE MATERIALS BY SIMULTANEOUSLY IMPROVING BOTH THE FIBER AND THE LOAD TRANSFER AT THE FIBER-MATRIX INTERFACE BY EMPLOYING A UNIQUE METHOD FOR IMPROVING LATERAL SUPPORT TO THE FIBER. IN SO DOING, IT REDUCES THE TENDENCY OF THE FIBER TO FAIL THROUGH MICROBUCKLING, PROVIDES ENHANCED COUPLING AND INTERLOCKING IN THE INTERFACIAL REGION, INCREASES COMPRESSIVE PROPERTIES, AND OPENS NEW DOORS TO OPTIMAL DESIGN OF DOD SYSTEMS USING COMPOSITES.

ADVANCED FUEL RESEARCH INC  
PO BOX 380343 - 87 CHURCH ST  
EAST HARTFORD, CT 06108

Program Manager: DAVID FENNER

Contract #:

Title: HIGH-TEMPERATURE SUPERCONDUCTOR FILMS ON SILICON WAFERS ADAPTED TO INTERCONNECT IN A MULTI-CHIP...

Topic #: DARPA90-114

Office:

ID #: 42451

IT IS COMMONLY AGREED THAT THE DEVELOPMENT OF ULTRA-HIGH DENSITY AND VERY HIGH SPEED ELECTRONICS FOR COMPUTING AND SIGNAL PROCESSING IS PRESENTLY LIMITED NOT BY THE CIRCUIT COMPONENTS THEMSELVES BUT RATHER BY THE ELECTRONIC PACKAGING. HIGH-TEMPERATURE SUPERCONDUCTOR (HTSC) FILMS ARE EXPECTED TO MAKE A SIGNIFICANT IMPACT ON THIS TECHNOLOGY FOR HIGH PERFORMANCE APPLICATIONS IF A NUMBER OF CRITICAL MATERIALS SYNTHESIS AND FABRICATION ISSUES CAN BE RESOLVED IN WAYS FAVORABLE TO THESE ENVISIONED APPLICATIONS. SUPERCONDUCTING THIN FILMS CAPABLE OF CARRYING HIGH CURRENT DENSITIES, AND THAT CAN BE PATTERNED INTO INTERCONNECT LINES OF ORDER 10 MICRON WIDTHS, HAVING EXTREMELY LOW INTRINSIC LOSS AND DISPERSION UP INTO AT LEAST 10 GHZ, HAVE CONSIDERABLE APPLICATIONS POTENTIAL AS FAST HIGH-DENSITY IC REQUIRE EXCELLENT CRYSTAL QUALITY, WHICH CAN ONLY OCCUR IF THE FILMS ARE EPITAXIAL WITH THE SUBSTRATE. SILICON WAFERS ARE CLEARLY THE BEST CHOICE OF SUBSTRATE FOR MANY TECHNOLOGICAL REASONS. WE PROPOSE HERE TO CONSIDER THE TECHNOLOGICAL ISSUES AROUND HTSC INTERCONNECTS FABRICATED FROM THIN Y-Ba-Cu-O (YBCO) FILMS ON ZIRCONIA FILMS ON SILICON WAFERS WHICH ARE STACKED INTO MULTI-LEVEL INTERCONNECT BOARDS WITH PAD CONTACTS WHICH ARE SUITABLE FOR MOUNTING SEMICONDUCTOR DEVICE CHIPS. THIS ARCHITECTURE IS THAT OF A MULTI-CHIP MODULE (MCM), AS IS WIDELY DISCUSSED IN THE CURRENT MICROELECTRIC, PACKAGING LITERATURE, BUT NOW EXTENDED TO HTSC FILMS ON SI. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - THE USE OF HIGH-T<sub>c</sub> SUPERCONDUCTOR INTERCONNECTS FOR ELECTRONIC CIRCUIT ASSEMBLIES WILL ADDRESS FUTURE MARKETS IN VERY HIGH PERFORMANCE ELECTRONICS, SUCH AS COMMUNICATIONS AND COMPUTING. THIS IS ANTICIPATED TO BE A HIGH DEMAND MARKET FOR BOTH COMMERCIAL AND MILITARY END USERS AND THIS TECHNOLOGY IS WIDELY CONSIDERED TO BE IN AN AREA OF GREAT IMPORTANCE FOR US INTERNATIONAL COMPETITIVENESS. KEY WORDS - SUPERCONDUCTIVITY, INTERCONNECTS, SILICON, CIRCUITS,

QUAD DESIGN TECHNOLOGY INC  
1385 DEL NORTE RD

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Program Manager: LAWRENCE RUBIN

Contract #:

Title: HIGH DENSITY MULTI-LAYER INTERCONNECTS FOR HIGH SPEED DIGITAL MCMS

Topic #: DARPA90-114

Office:

ID #: 42509

THE CONVERSION TO THE USE OF HIGH-DENSITY MULTI-CHIP MODULES TO SAVE SIZE, WEIGHT AND COST, AND TO REDUCE SIGNAL PROPAGATION DELAYS TO ALLOW DIGITAL SYSTEMS TO REALIZE THE PERFORMANCE BENEFITS OF THE INCREASING IC CLOCK SPEEDS IS WELL KNOWN. THOUGH INITIAL MCMS

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ARE SMALLER, IT IS CLEAR THAT MID 1990S MCMS WILL EXTEND TO AT LEAST 6" SIZES, OPERATING AT 100 TO 200 MHZ CLOCK RATES FOR CMOS (MUCH HIGHER FOR GAAS). A CRITICAL PROBLEM WITH THESE LARGE MCMS IS THAT, WHILE THE REQUIRED INTERCONNECT DENSITIES REQUIRE THE USE OF FAIRLY FINE LINEWIDTHS (-5 UM TYPICALLY), EVEN WHEN IMPLEMENTED IN COPPER OR GOLD THESE LINES BECOME VERY ATTENUATING, DISTORTIVE AND SLOW BEYOND LENGTHS OF A FEW INCHES. THE USE OF HIGH TEMPERATURE SUPERCONDUCTORS FOR THE SIGNAL LINES WOULD VIRTUALLY COMPLETELY ELIMINATE SIGNAL LINE ATTENUATION AT FREQUENCIES OF INTEREST, EVEN AT 1 UM LINEWIDTHS (ALLOWING INCREASED DENSITIES), PLUS PROVIDING NEAR-PERFECT SHIELDING FOR MIXED-MODE ANALOG/DIGITAL MCMS. CURRENTLY, HOWEVER, HTSC FILMS ARE EPITAXIALLY GROWN ON HIGH ER SUBSTRATES, WHEREAS MCMS REQUIRE A MULTI-LAYER INTERCONNECT TECHNOLOGY WITH LOW ER DIELECTRICS. THE GOAL OF THE PROPOSED STUDY IS TO IDENTIFY PROMISING TECHNICAL APPROACHES TO FABRICATING HTSC MULTI-LAYER INTERCONNECTS FOR HIGH DENSITY MCMS OR BACKPLANES. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - THE DEVELOPMENT OF A PRACTICAL 80 DEGREE K HTSC MULTI-LAYER INTERCONNECT TECHNOLOGY WILL MAKE POSSIBLE LARGE, HIGH DENSITY MCMS FOR HIGH SPEED CMOS OR GAAS DIGITAL (OR MIXED-MODE) SYSTEM APPLICATIONS. THIS TECHNOLOGY SHOULD SEE APPLICATION IN A WIDE RANGE OF MILITARY SYSTEMS, AS WELL AS COMMERCIAL PRODUCTS, ASSUMING THE AVAILABILITY OF EFFICIENT, INEXPENSIVE 80 DEGREE K REFRIGERATORS. KEY WORDS - MULTI-LAYER, SUPERCONDUCTING, INTERCONNECTS, MCM, HIGH-DENSITY, HIGH-SPEED, PACKAGING, HTSC

ADAPTIVE SOLUTIONS INC  
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Program Manager: TOBY SKINNER

Contract #:

Title: UNIQUE APPLICATIONS FOR ARTIFICIAL NEURAL NETWORKS

Topic #: DARPA90-115

Office:

ID #: 42449

WE PURPOSE TO DEMONSTRATE THE FEASIBILITY OF SPEECH RECOGNITION ON A VLSI NEUROCOMPUTER. THE SPEECH RECOGNITION SYSTEM PERFORMS SPEAKER-INDEPENDENT RECOGNITION OF SPOKEN ENGLISH LETTERS. THE CURRENT IMPLEMENTATION OF THE SYSTEM, NOW RUNNING ON A SUN 4 WORKSTATION, CLASSIFIES LETTERS OF THE ENGLISH ALPHABET AT 94% ACCURACY - THE BEST REPORTED PERFORMANCE OF ANY SYSTEM ON THIS DIFFICULT TASK. THE HIGH LEVEL OF ACCURACY IS OBTAINED BY TRAINING NEURAL NETWORKS TO MAKE THE IMPORTANT CLASSIFICATION DECISIONS AT EACH LEVEL OF THE SYSTEM. NEURAL NETWORKS ARE USED TO TRACK PITCH, TO LOCATE SPEECH BOUNDARIES, AND TO CLASSIFY LETTERS. THE GOAL OF THE PHASE I RESEARCH IS TO IMPLEMENT A COMPLETE RECOGNITION SYSTEM IN WHICH NEURAL NETWORK CLASSIFICATION IS PERFORMED IN REAL TIME ON THE ASI BOARD. THE RESEARCH CONSISTS OF: (A) EXPERIMENTS NEEDED TO MODIFY THE CURRENT RECOGNITION SYSTEM TO MEET THE COMPUTATIONAL REQUIREMENTS OF THE BOARD; (B) TRAINING THE NEURAL CLASSIFIERS ON THE ASI SIMULATOR; AND (C) IMPLEMENTING THE CLASSIFICATION MODULES ON THE ASI NEUROCOMPUTER. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - THERE ARE A VARIETY OF NEAR-TERM APPLICATIONS FOR SPEAKER-INDEPENDENT RECOGNITION OF LETTERS AND DIGITS, INCLUDING CREDIT CARD VERIFICATION AND AUTOMATIC DIRECTORY RETRIEVAL. A STATISTIC THAT IS COMMONLY MENTIONED BY RESEARCHERS AT TELEPHONE COMPANIES IS THAT EVERY SECOND REMOVED FROM AN AVERAGE INTERACTION INVOLVING A HUMAN OPERATOR SAVES THE COMPANY APPROXIMATELY \$10 MILLION PER YEAR. KEY WORDS - NEUROCOMPUTERS, NEURAL NETWORKS, SPEECH RECOGNITION, SIGNAL PROCESSING, CLASSIFICATION

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Contract #:

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DARPA Solicitation 90.2

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Title: UNIQUE APPLICATIONS FOR ARTIFICIAL NEURAL NETWORKS  
Topic #: DARPA90-115                      Office:                      ID #: 42450

IN THIS PROPOSAL, WE WOULD LIKE TO CONSTRUCT AN AUTOMATIC HANDWRITTEN CHARACTER RECOGNITION SYSTEM BASED ON NEURAL NETWORK PRINCIPLES. A PRELIMINARY STUDY HAS RESULTED IN A MODEL SYSTEM THAT COULD RECOGNIZE HANDWRITTEN ENGLISH ALPHABET AND ARABIC NUMERALS IN A TENTH OF A SECOND ON A 386 MICRO-COMPUTER WITH AVERAGE ACCURACY OVER 95% IN AN OFF-LINE WRITER INDEPENDENT MODE. THE GENERALIZATION IS SO GOOD THAT IT CAN RECOGNIZE EVEN LETTERS WITH ZIGZAG BROAD STROKES THAT ARE WIDELY DISTORTED FROM ANY OF THE LETTER PATTERNS THAT IT HAD SEEN BEFORE. THE SYSTEM IS ALSO VERY SIMPLE THAT IT TAKES ONLY ABOUT 100 KBYTE OF MEMORY STORAGE. WE ARE PLANNING TO CONNECT IT TO A TEXT TO SPEECH SYSTEM TO FORM A TOTALLY AUTOMATIC SYSTEM THAT COULD READ WRITTEN TEXTS OUT ALOUD. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - AUTOMATIC HANDWRITTEN CHARACTER RECOGNITION SYSTEM BASED ON NEURAL NETWORK PRINCIPLES IS SIMPLE, EFFICIENT, AND ACCURATE. ITS PERFORMANCE SEEMS TO SURPASS GREATLY ANY COMMERCIALY AVAILABLE SYSTEM KNOWN. IT CAN BE USED AS A FRONT END FOR A DOCUMENT PROCESSING SYSTEM IT TO CLASSIFY OR RETRIEVE TEXT DATA AUTOMATICALLY. WITH MODIFICATIONS, IT COULD ALSO BE FITTED INTO AN AUTOMATIC TARGET RECOGNITION SYSTEM. THE COMMERCIAL AND MILITARY POTENTIAL OF THIS SYSTEM IS ENORMOUS. KEY WORDS - NEURAL NETWORK, HANDWRITTEN, RECOGNITION, CHARACTER

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Program Manager: LARRY HORNER

Contract #:

Title: APPLICATIONS OF NEURAL NETWORKS TO FORWARD ERROR CORRECTION ANALYSIS  
Topic #: DARPA90-115                      Office:                      ID #: 42468

ARTIFICIAL NEURAL NETWORKS (ANN) HAVE PROVEN CAPABILITY IN FORWARD ERROR CORRECTION (FEC) ENCODING AND DECODING. THIS PROPOSAL STRIVES TO ADDRESS THE POTENTIAL THAT ANNS MAY ENABLE NON-COOPERATING RECEIVERS TO IDENTIFY, CONFIGURE, AND RECOVER INFORMATION FROM A COMPLEX COMMUNICATION CHANNEL. MODERN DIGITAL COMMUNICATION SYSTEMS HAVE BEEN DESIGNED TO TRANSMIT DATA AT EXTREMELY HIGH RATES - SOMETIMES IN EXCESS OF 100MBITS/SECOND. TO PROTECT THE INFORMATION IN THESE SYSTEMS FROM ERRORS, FORWARD ERROR CODING (FEC) HAS BEEN IMPLEMENTED AS A CRITICAL COMPONENT IN THESE SYSTEMS. FORWARD ERROR CORRECTION IS A LOW LATENCY METHOD OF RECOVERING THE DATA THROUGH A COMPUTATIONAL PROCESS THAT RELIES ON REDUNDANCY IN THE TRANSMITTED DATA. THE ABILITY TO RAPIDLY IDENTIFY AND DECODE COMMUNICATION CHANNELS CONTAINING FECS IS OF GREAT INTEREST TO ELEMENTS WITHIN DOD. RESEARCHERS HAVE BEEN SUCCESSFUL IN THE DEVELOPMENT OF ANNS CAPABLE OF PERFORMING THE CODING AND DECODING THE FEC IN COOPERATING SYSTEMS. THIS HAS STIMULATED THE CONCEPT DEVELOPED IN THIS PROPOSAL. THE CURRENT ANALYSIS TECHNIQUE TO IDENTIFY A CHANNEL AS HAVING FEC IS A BRUTE FORCE, MAN AND MACHINE INTENSIVE TASK, USING ALGEBRAIC TECHNIQUES, AND FREQUENCY ANALYSIS. IT IS THE INTENT OF THIS EFFORT TO INVESTIGATE THE POSSIBILITY THAT ANNS WILL BE ABLE TO IMPROVE THE RESULTS OF PROCESSING AN UNKNOWN FEC. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - THE BENEFITS OF THE APPLICATION OF ANNS TO FECS ARE TO BE GAINED IN THE IMPROVED EFFICIENCY IN ANALYZING NEW AND COMPLEX COMMUNICATION CHANNELS. AN ADDITIONAL BENEFIT COULD BE GAINED IN THE IMPLEMENTATION OF ADAPTIVE ERROR CORRECTING RECEIVERS, DEVICES CAPABLE OF IDENTIFYING AND TRACKING THE ERROR CODE SELECTION OF A TRANSMITTER, WHERE THE TRANSMITTER SELECTS THE MODE OF ERROR CORRECTION IN RESPONSE TO

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SAN DIEGO, CA 92121

Program Manager: ROBERT HECHT- NIELSEN

Contract #:

Title: ANALOG NEURAL NETWORK CONTROLLER CHIP

Topic #: DARPA90-115

Office:

ID #: 42485

SINGLE SENSOR INPUT/SINGLE CONTROL OUTPUT ADAPTIVE CONTROLLER MODULES HAVE OBIATED THE NEED FOR DETAILED CONTROL SYSTEM DESIGN IN MANY INDUSTRIAL MANUFACTURING SYSTEMS USED FOR PRODUCING BOTH MILITARY AND CIVILIAN MATERIEL. THIS PROJECT WILL PRODUCE A NEW NEURAL NETWORK BASED CHIP-LEVEL ADAPTIVE CONTROLLER WITH THE ADDITIONAL ADVANTAGES THAT IT CAN HANDLE UP TO 8 SENSOR INPUTS AND PRODUCE UP TO 4 CONTROL OUTPUTS AND CAN BE CONTINUOUSLY TRAINED "ON THE JOB" USING SETPOINT-DRIVEN UNSUPERVISED TRAINING (LIKE THE EXISTING ONE-CHANNEL SYSTEMS) OR REINFORCEMENT TRAINING (I.E., BY MIMICKING THE ACTIONS OF ANOTHER CONTROLLER - SUCH AS A HUMAN PILOT). THE MODE OF TRAINING CAN BE CHANGED AT ANY TIME. THE CONTROLLER CHIP WILL EMPLOY ANALOG WEIGHT MULTIPLICATION CIRCUITS BASED UPON A CAPACITOR VOLTAGE REFERENCE WEIGHT VALUE WHICH IS PERIODICALLY REFRESHED, AS IN A DYNAMIC RAM. THE CHIP WILL OFFER DIGITAL INPUTS AND OUTPUTS. THE CONTROLLER CHIP WILL BE ABLE TO LEARN BOTH PID (I.E., LINEAR) AND NON-PID (I.E., NON-LINEAR) CONTROL LAWS, AS REQUIRED BY THE APPLICATION. THE EFFICACY OF THE GENERAL ADAPTIVE MULTI-CHANNEL NEURAL NETWORK CONTROL APPROACH TO BE USED HAS ALREADY BEEN DEMONSTRATED IN A NUMBER OF SPECIFIC APPLICATIONS. IT INCORPORATES HNC'S PATENTED GRADED LEARNING NEURAL NETWORK REINFORCEMENT TRAINING TECHNOLOGY THAT HAS DEMONSTRATED ITS EFFECTIVENESS IN CONTROL APPLICATIONS RANGING FROM BROOMSTICK BALANCING TO FLIGHT CONTROL. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - THIS CHIP WILL SIGNIFICANTLY REDUCE THE COST AND DIFFICULTY OF DESIGNING CONTROLLERS FOR A VARIETY OF MILITARY AND COMMERCIAL SYSTEMS WHICH HAVE FEWER THAN 8 SENSORS AND 4 CONTROLS (E.G., AUTOPILOTS, ENGINE CONTROLLERS, GUN DIRECTORS, CHEMICAL REACTOR CONTROLLERS, ETC.). FOR SOME APPLICATIONS THE CHIP MAY ELIMINATE THE NEED FOR CONTROLLER DESIGN AND/OR FOR PERIODIC SYSTEM COMPONENT ADJUSTMENTS. THE CHIP WILL ALSO BE ABLE TO IMPLEMENT FUZZY LOGIC CONTROL SYSTEMS AND HYBRID NEURAL NETWORK/FUZZY LOGIC CONTROL SYSTEMS.

IN-MARCH INC

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Program Manager: DR KENDALL NYGARD

Contract #:

Title: UNIQUE APPLICATIONS FOR ARTIFICIAL NEURAL NETWORKS

Topic #: DARPA90-115

Office:

ID #: 42487

THE INVESTIGATION HAS THE FOLLOWING OBJECTIVES: 1. ESTABLISH THAT MODULAR NEURAL NETWORKS, WORKING SYNERGISTICALLY WITH GENETIC SEARCH, PROVIDE A UNIQUELY POWERFUL MEANS OF INTELLIGENTLY CONTROLLING HEURISTIC MATHEMATICAL ALGORITHMS FOR LARGE-SCALE VEHICLE ROUTING AND SCHEDULING PROBLEMS. THE DESIGN LENDS ITSELF NATURALLY TO PARALLEL COMPUTING ON COMPUTING NETWORKS. 2. CODE A PROTOTYPE SYSTEM USING THE DESIGN, DEMONSTRATING THE VIABILITY AND STRENGTHS OF THE SYSTEM. 3. PREPARE A DETAILED REPORT THAT INCLUDES THE DESIGN, RESULTS OF COMPUTATIONAL EXPERIMENTS, AND FUTURE PLANS FOR THE TECHNOLOGY. THE METHODS BUILD UPON THE PROVEN STRENGTHS OF OPERATIONS RESEARCH TECHNIQUES (E.G., GENERALIZED ASSIGNMENT ALGORITHMS) FOR VEHICLE ROUTING, BUT SIGNIFICANTLY AMPLIFY THE PERFORMANCE OF THE TECHNIQUES BY USING NEURAL NETWORK AND GENETIC SEARCH PARADIGMS TO SET PARAMETERS AND ADAPTIVELY GUIDE THEIR COMPUTATIONS. THE METHODS ARE NEW TO THE VEHICLE ROUTING AND SCHEDULING PROBLEM SOLVING DOMAIN. PRELIMINARY TESTING SUGGESTS THAT SOLUTION QUALITY IS SIGNIFICANTLY BETTER THAN WHAT ANY OF THE UNDERLYING MATHEMATICAL METHODS WORKING INDIVIDUALLY CAN ACHIEVE. THE PRIMARY ISSUES TO BE RESOLVED INCLUDE THE TOPOLOGY OF THE NEURAL NETWORKS, THE PARAMETERS AND DEGREES OF FREEDOM OF THE GENETIC

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ALGORITHMS, AND SOME DETAILS OF THE UNDERLYING HEURISTIC BEING CONTROLLED. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - TRANSPORTATION OF GOOD AND PEOPLE IS A PERVASIVE AND CONSTANT ACTIVITY WITHIN BOTH MILITARY AND COMMERCIAL OPERATIONS. GIVEN THE SCOPE OF THE ASSOCIATED VEHICLE ROUTING AND SCHEDULING PROBLEMS, EVEN

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Program Manager: DR MICHAEL KUPERSTEIN

Contract #:

Title: NEURAL NETWORK CONTROLLER FOR AUTONOMOUS AND ADAPTIVE ROBOT DYNAMICS

Topic #: DARPA90-115

Office: DSO

ID #: 50328

CURRENT METHODS IN MOTOR CONTROL HAVE PROBLEMS DEALING EFFECTIVELY WITH HIGHLY VARIABLE ENVIRONMENTS AND SENSORY-MOTOR PARAMETERS. THE PROPOSED WORK OVERCOMES SOME OF THESE DIFFICULTIES BY BUILDING A NEURAL CONTROLLER THAT LEARNS ADAPTIVE MOTOR CONTROL FROM ITS OWN EXPERIENCE. THE OBJECTIVE OF THE PROPOSED PHASE I STUDY IS TO IMPLEMENT A SINGLE-JOINTED ARM AND CONTROLLER FOR POSITIONING UNFORESEEN PAYLOADS WITH ACCURATE AND STABLE MOVEMENTS. THE PROPOSED IMPLEMENTATION WILL BE BASED ON A WORKING COMPUTER SIMULATION THAT HAS BEEN SHOWN TO ACHIEVE AUTONOMOUS ADAPTIVE CONTROL. THE NEURAL ARM HAS BEEN DESIGNED TO ADAPTIVELY CONTROL ANY NUMBER OF SENSORY INPUTS WITH LINKS OF ANY NUMBER OF JOINTS. THE FEEDFORWARD NATURE OF CONTROL WILL ALLOW PARALLEL IMPLEMENTATION IN REAL TIME ACROSS MULTIPLE JOINTS. IT WILL TOLERATE INTERNAL NOISE, PARTIAL SYSTEM DAMAGE AND CHANGES IN THE MECHANICAL AND SENSORY PARAMETERS OF THE ROBOT AS THEY OCCUR OVER TIME. THIS ADAPTABILITY ELIMINATES THE NEED FOR OPERATOR CALIBRATION. IN PHASE II OF THIS PROJECT, THIS NEURAL CONTROLLER WILL BE EXTENDED TO MULTIPLE JOINTS.

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Program Manager: SU-SHING CHEN

Contract #:

Title: INTELLIGENT CONTROL OF SEMICONDUCTOR MANUFACTURING PROCESSES

Topic #: DARPA90-116

Office:

ID #: 42447

AN INTELLIGENT EQUIPMENT ARCHITECTURE FOR CLUSTER AND IN-SITU SEMICONDUCTOR MANUFACTURING PROCESSES IS PROPOSED. IT HAS TWO COMPONENTS: (1) MANUFACTURING EQUIPMENT - EQUIPMENT HARDWARE AND SENSORS, AND (2) INTELLIGENT EXPERT WORKSTATION - A HYBRID AI/NEURAL NETWORK EXPERT SYSTEM. THE INTELLIGENT CONTROL SCHEME IN THE INTELLIGENT EXPERT SYSTEM HAS THE FOLLOWING FEATURES: (1) EQUIPMENT/PROCESS MODELING BY NEURAL NETWORKS, (2) NEURAL NETWORK HARDWARE EMULATOR AS CONTROLLER, (3) SENSOR-BASED CONTROL, (4) LOCAL SIMULATION BY NEURAL NETWORKS FOR CONTROL DESIGN, (5) HEURISTICS FOR CONTROL DESIGN BY RULE-BASED SUBSYSTEM, (6) LEARNING, MONITORING, AND CONTROL BY THE SAME MODELS, (7) SENSOR DRIFTS AND NOISES MAY BE MONITORED BY NEURAL NETWORKS, (8) TIGHT COUPLING OF MANUFACTURING LINE AND ITS SIMULATOR. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - A UNIQUE CONTROL SCHEME WITH REAL-TIME, ADAPTIVE, AND MODELING CAPABILITIES IS CRUCIAL TO VLSI AND ULSI DEVICES AND ADVANCED ELECTRONIC MATERIAL PROCESSING. THIS INTELLIGENT EQUIPMENT ARCHITECTURE FOR CLUSTER PROCESSING CAN ACHIEVE: (1) PROCESS UNIFORMITY, (2) HIGHER YIELD, (3) INTEGRATION OF PROCESS MEASUREMENT AND CONTROL, (4) PROCESS PROGRAMMABILITY, (5) MIXING TECHNOLOGIES, AND (6) EFFICIENT FABRICATION. KEY WORDS - INTELLIGENT CONTROL, EQUIPMENT/PROCESS MODELS, SENSOR-BASED CONTROL, INTELLIGENT EQUIPMENT ARCHITECTURE, MODEL-BASED CONTROL, CLUSTER PROCESSING, NEURAL NETWORK



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CONTROLLER, HYBRID AI/NEURAL NETWORK EXPERT SYSTEM.

SEMIMAC INC

7855 S RIVER PKWY - STE 103

TEMPE, AZ 85284

Program Manager: JOHN COULTHARD

Contract #:

Title: ADAPTIVE CONTROL AND HIERARCHICAL SYSTEMS FOR A COMPLEX MANUFACTURING ENVIRONMENT

Topic #: DARPA90-116

Office:

ID #: 42517

THIS PROPOSAL ADDRESSES THE TECHNICAL CHALLENGE TO U.S. INDUSTRY FOR DEVELOPMENT OF CONTROL SYSTEMS THAT ARE ADAPTABLE TO CHANGES IN THE COMPLEX MULTIPLE, CONCURRENT PROCESSES OF A SEMICONDUCTOR MANUFACTURING ENVIRONMENT. THE PROPOSED WORK IS EXPLORATORY RESEARCH WHICH WILL RESULT IN THE DEVELOPMENT OF AN ABSTRACT SETTING FOR THE CONTROL SYSTEMS, INVOLVING A THREE TIER HIERARCHICAL APPROACH, WITH EACH TIER BASED UPON A DISTINCT CONTROL METHODOLOGY. PROGRESSING OUTWARDS TOWARD THE SYSTEM OPERATOR, THESE TIERS WILL BE BASED ON TRADITIONAL PID AND PROCESS CONTROL, ADAPTIVE CONTROL SYSTEMS AND CONTROL FOR DISCRETE EVENT SYSTEMS. CONSIDERATION WILL BE GIVEN TO THE INCORPORATION OF EXPERT SYSTEMS, EMBEDDED PROCESS SIMULATORS AND NEURAL NETWORKS. THE ABSTRACT SETTING WILL PROVIDE A MEANS OF ANALYZING AND DESIGNING CONTROL SYSTEMS FOR THE COMPLEX SEMICONDUCTOR MANUFACTURING ENVIRONMENT. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - ADVANCED CONTROL SYSTEMS FOR THE SEMICONDUCTOR MANUFACTURING ENVIRONMENT CAN BE CONSIDERED AN ENABLING TECHNOLOGY THAT OFFERS SIGNIFICANT POTENTIAL FOR PRODUCTIVITY IMPROVEMENT. THERE ARE OVER 350 WAFER FABRICATION SITES IN THE U.S. WHERE ADVANCED CONTROLS TECHNOLOGY INSERTION COULD RESULT IN IMPROVED YIELDS, THROUGHPUT, QUALITY, CYCLE TIMES AND PROCESS FLEXIBILITY. KEY WORDS - MANUFACTURING, ADAPTIVE CONTROL, HIERARCHICAL, CONTROL THEORY, PROCESS SIMULATION, AUTOMATION, SEMICONDUCTORS, MICROELECTRONICS

CONDOR SYSTEMS INC

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Program Manager: DR NORMAN KRASNER

Contract #:

Title: APPLICATION OF ACOUSTIC CHARGE TRANSPORT TECHNOLOGY TO BLIND EQUALIZATION OF COMPLEX DIGITAL ...

Topic #: DARPA90-118

Office:

ID #: 42465

THE ADVENT OF COMMUNICATION SYSTEMS EMPLOYING COMPLEX MODULATION FORMATS HAS IMPOSED INTERCEPT SYSTEMS. DEMODULATION OF SIGNALS SUCH AS 16 AND 64 AND 256 QAM SIGNALS REQUIRES MINIMIZING INTERSYMBOL INTERFERENCE AND IS POSSIBLE ONLY THROUGH THE USE OF ADAPTIVE EQUALIZATION. RECENTLY THERE HAS BEEN INCREASED INTEREST IN UTILIZING BLIND EQUALIZATION METHODS FOR THIS PURPOSE - THAT IS, METHODS THAT DO NOT REQUIRE THE TRANSMISSION OF SPECIALIZED "TRAINING" SEQUENCES IN ORDER TO PERFORM THE EQUALIZATION FUNCTION. THE ADVENT OF ACOUSTIC CHARGE TRANSPORT DEVICES PROMISES TO PERMIT COST EFFECTIVE AND HIGH PERFORMING ADAPTIVE EQUALIZATION, AS COMPARED TO THE CURRENT EXPENSIVE ALL DIGITAL APPROACHES. THIS PROPOSED STUDY ADDRESSES THE APPLICATION OF ACOUSTIC CHARGE TRANSPORT TECHNOLOGY TO BLIND EQUALIZATION OF COMPLEX DIGITALLY MODULATED SIGNALS. IT IS DIRECTED TOWARD MILITARY AND OTHER U.S. GOVERNMENT AGENCIES REQUIREMENTS FOR RECONNAISSANCE/ECM AS WELL AS TOWARD GOVERNMENT COMMUNICATIONS APPLICATIONS. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - THE RESULTING STUDY WILL DETERMINE THE EFFECTIVENESS OF ACT TECHNOLOGY IN SOLVING THE PCM BLIND EQUALIZATION PROBLEM AND DEVELOPMENT ARCHITECTURES SUITABLE FOR EQUALIZER/DEMODULATOR DEVELOPMENT. PRINCIPLE EMPHASIS WILL BE TOWARD

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REDUCING THE COST OF SUCH EQUALIZATION VERSUS CURRENT ALL DIGITAL APPROACHES. KEY WORDS  
- EQUALIZATION, ACOUSTIC CHARGE TRANSPORT, ACT, PCM, ADAPTIVE FILTERING

ELECTRONIC DECISIONS INC  
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Program Manager: DR DANIEL FLEISCH

Contract #:

Title: ACT ANALOG COMPUTER FOR PATTERN RECOGNITION

Topic #: DARPA90-118

Office:

ID #: 42470

A NEW COMPUTATIONAL ENGINE BASED ON THE EMERGING TECHNOLOGY OF ACOUSTIC CHARGE TRANSPORT (ACT) HAS BEEN DEVELOPED TO PROCESS ANALOG SIGNALS OR DIGITAL DATA AT SPEEDS MORE THAN THREE ORDERS OF MAGNITUDE BEYOND CURRENT DIGITAL SIGNAL PROCESSOR CHIPS. THE ACT PROGRAMMABLE SIGNAL PROCESSOR IS A MASSIVELY PARALLEL ANALOG DEVICE ON A SINGLE GALLIUM-ARSENIDE CHIP WHICH MAY BE USED TO PERFORM CORRELATIONS WITH MULTIPLY-AND-ACCUMULATIVE TIMES OF LESS THAN 30 PICOSECONDS. THE ACT PROCESSOR MAY BE USED AS A PATTERN MATCHER TO PERFORM HIGH-SPEED CORRELATION AGAINST A LIBRARY OF REFERENCE FUNCTIONS; THIS PROCESS IS USEFUL IN APPLICATIONS RANGING FROM VOICE RECOGNITION AND IMAGE PROCESSING TO IDENTIFICATION OF WIDEBAND SIGNALS IN MILITARY ELECTRONIC WARFARE SYSTEMS. THE PROPOSED PROGRAM SEEKS TO DEMONSTRATE THE TECHNICAL FEASIBILITY OF USING THE ACT DEVICE AS A PATTERN MATCHER BY EVALUATING THE CHARACTERISTICS OF POTENTIAL REFERENCE SIGNALS, USING EXISTING ACT PROCESSORS TO MEASURE THE ABILITY TO RECOGNIZE SUCH SIGNALS, AND PROJECTING THE PERFORMANCE OF AN OPERATIONAL ACT-BASED PATTERN MATCHING SYSTEM. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - IN ADDITION TO APPLICATION IN MILITARY SIGNAL-RECOGNITION SYSTEMS, ACT PATTERN MATCHERS MAY BE USED IN VOICE-RECOGNITION SYSTEMS, MACHINE VISION, AND "SMART" TRIGGERS FOR TEST INSTRUMENTATION. KEY WORDS - ACOUSTIC CHARGE TRANSPORT, GALLIUM ARSENIDE, ANALOG PROCESSING, PATTERN RECOGNITION

MIRAGE SYSTEMS  
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Program Manager: ROBERT EIN

Contract #:

Title: APPLICATIONS FOR ACOUSTIC CHARGE TRANSPORT TECHNOLOGY

Topic #: DARPA90-118

Office:

ID #: 42497

A PROTOTYPE OF ESM/ELINT RECEIVER SYSTEM UTILIZING ACOUSTIC CHARGE TRANSPORT (ACT) TECHNOLOGY IN AN ADAPTIVE CHANNELIZER IS PROPOSED. THE TYPES OF ACT TECHNOLOGY TO BE EXPLOITED IN THIS DEVELOPMENT ARE TUNABLE FILTERS WITH PROGRAMMABLE BANDWIDTHS AND ADJUSTABLE DELAY LINES FOR DELAY LINE DISCRIMINATORS. A VERY LONG DELAY USING ACT TECHNOLOGY WILL ALSO BE INVESTIGATED. THIS ADAPTIVE RECEIVER BUILDS UPON PREVIOUS RECEIVER DESIGNS BY DEVELOPING A NEW APPROACH TO THE RECEIVER ARCHITECTURE. THE DEVELOPMENT OF THE NEXT GENERATION OF ESM/ELINT RECEIVER TECHNOLOGY IS INTENDED TO BE USED WITH RECONNAISSANCE AND SURVEILLANCE SYSTEMS TO BE DEPLOYED IN THE 1995-2010 TIME FRAME. THESE SYSTEMS WILL BE EMPLOYED ON VARIOUS RECONNAISSANCE PLATFORMS, AGAINST A VARIETY OF AIR, GROUND, AND SEA TARGETS. THE ESM/ELINT SYSTEM IS INTENDED TO DETECT, LOCATE, AND RECOGNIZE THREATS LIKELY TO BE ENCOUNTERED IN SUPPORT OF COUNTER-NARCOTIC OPERATIONS AND LOW INTENSITY CONFLICT AREAS. THE ESM/ELINT RECEIVER SYSTEM IS CAPABLE OF AUTONOMOUS, REAL TIME TARGET EXPLOITATION AND ANALYSIS OF THE ESM/ELINT DATA. ACT TECHNOLOGY PROVIDES THE UNIQUE REAL TIME TUNING AND FAST SIGNAL MEASUREMENT CAPABILITY REQUIRED BY THIS APPLICATION. ANTICIPATED BENEFITS/ POTENTIAL COMMERCIAL APPLICATIONS - THIS EFFORT IS

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EXPECTED TO YIELD A SOLID FOUNDATION FOR DEVELOPMENT OF HARDWARE REQUIREMENTS OF ACT DEVICES. THE REQUIREMENTS DEVELOPED FOR THESE SUB-SYSTEMS MAY INDIVIDUALLY OR AS A WHOLE BE USED AS A METRIC MEASUREMENT FOR EXPECTED PERFORMANCE. THE RESULTS OF THE DETERMINATION OF THE REQUIRED MEASUREMENT ASSETS AND PROCESSING REQUIREMENTS WILL BUILD A FRAMEWORK FOR A PHASED DEVELOPMENT OF A FULLY OPERATIONAL SYSTEM THAT PROVIDES THE FLEXIBILITY NEEDED ON VARIOUS INTERCEPT PLATFORMS. KEY WORDS - ACT, CHANNELIZER, ELINT/ESM, ADVANCED RECEIVER TECHNOLOGY, PULSE DATA SORTER, PROGRAMMABLE FILTER, IFM, SIMULTANEOUS

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Program Manager: BONITA LEE

Contract #:

Title: AUTOMATIC DETECTION OF POWERLINES FROM SAR AND MULTISPECTRAL IMAGERY

Topic #: DARPA90-119

Office:

ID #: 42455

THIS PROPOSAL SEEKS TO ESTABLISH THE FEASIBILITY OF APPLYING NEWLY DEVELOPED MORPHOLOGY-BASED DETECTION ALGORITHMS TO THE POWERLINE DETECTION PROBLEM IN SAR AND MULTISPECTRAL IMAGERY AND TO DESIGN AN OVERALL PROGRAM TO INTEGRATE THIS TECHNOLOGY INTO A COMPLETE MAP VALIDATION AND UPDATING SYSTEM. THE IMPORTANCE OF THIS OUR APPROACH IS TWOFOLD. FIRST, DETECTION PERFORMANCE CAN BE DRAMATICALLY IMPROVED FOR THE DETECTION OF TARGETS IN SEVERE BACKGROUND CLUTTER, IN WHICH EXCESSIVE FALSE ALARMS ARE A TYPICAL PROBLEM. SECONDLY, MORPHOLOGY-BASED ALGORITHMS CAN BE IMPLEMENTED IN VERY HIGH-SPEED HARDWARE BECAUSE THE FUNDAMENTAL OPERATIONS INVOLVE ONLY LOGICAL COMPARISONS (MIN AND MAX). THE ADVANTAGES OF THIS APPROACH MAKE IT IDEALLY SUITED FOR PROCESSING LARGE VOLUMES OF SAR AND MULTISPECTRAL DATA AT VERY LOW COMPUTATIONAL COST USING SPECIALIZED HARDWARE OR FINE-GRAINED PARALLEL COMPUTERS. OVER THE PAST SEVERAL YEARS ATLANTIC AEROSPACE ELECTRONICS CORPORATION HAS DEVELOPED AND DEMONSTRATED THIS MORPHOLOGY-BASED TECHNOLOGY FOR DETECTING NON-RESOLVED AND RESOLVED TARGETS IN HIGH CLUTTER BACKGROUNDS. THIS WORK WAS ACCOMPLISHED IN SEVERAL PROGRAMS SPONSORED BY THE AIR FORCE, IN WHICH BASIC ALGORITHM COMPONENTS WERE DEVELOPED, ALGORITHM PERFORMANCE WAS QUANTIFIED ANALYTICALLY AND THEIR OPERATION WAS VERIFIED EXPERIMENTALLY USING RECORDED REAL DATA FROM AIRBORNE SAR AND GROUND-BASED DOPPLER RADARS, AS WELL AS PASSIVE ELECTRO-OPTICAL SENSORS. OUR PROPOSAL IS TO EVOLVE THIS EXISTING TECHNOLOGY TO THE POWERLINE DETECTION PROBLEM. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - THE PHASE I RESEARCH WILL DEMONSTRATE THE FEASIBILITY AND POTENTIAL OF THE MORPHOLOGICAL PROCESSING APPROACH AND LAY THE GROUNDWORK FOR FURTHER ALGORITHM DEVELOPMENT IN A PHASE II PROGRAM USING EXTENSIVE RECORDED SENSOR DATA. THIS RESEARCH WILL ALSO RESULT IN THE DEFINITION OF A LONG TERM PROGRAM TO INTEGRATE THIS TECHNOLOGY INTO MAP UPDATING SYSTEMS.

PACIFIC-SIERRA RESEARCH CORP  
1401 WILSON BLVD - STE 1100

ARLINGTON, VA 22209

Program Manager: ERNEST CARROL

Contract #:

Title: DEVELOPMENT OF AUTOMATED METHODS OF EXTRACTING POWER LINES FROM DIGITAL SYNTHETIC APERTURE RADAR ...

Topic #: DARPA90-119

Office:

ID #: 42503

THIS PROPOSAL INVOLVES THE DEVELOPMENT OF TECHNIQUES FOR AUTOMATED PROCESSING OF SYNTHETIC APERTURE RADAR (SAR) IMAGERY. SPECIFICALLY, THIS TASK INVOLVES FINDING ALTERNATING CURRENT (AC) POWER LINES AND RELATED STRUCTURES FROM HIGH-RESOLUTION AIRBORNE SAR (ASAR)

SMALL BUSINESS INNOVATION RESEARCH PROGRAM - PHASE I  
DARPA Solicitation 90.2

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IMAGES. WE WILL IDENTIFY AREAS FOR IMPROVEMENT AND DEVELOP NEW TECHNIQUES AS NECESSARY TO STRENGTHEN WEAK AREAS. WE WILL ESTABLISH A METHODOLOGY AND AN APPROACH TO THE DEVELOPMENT OF AN OPERATIONAL CAPABILITY. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - THIS EFFORT WILL LEAD TO A FAST, RELIABLE METHOD OF SCREENING AND EXPLOITING POWER LINES ON SAR IMAGERY. THIS, IN TURN, WILL CONTRIBUTE TO IMPROVED INTELLIGENCE AND OVERALL SUCCESS ON THE BATTLEFIELD. KEY WORDS - SAR, IMAGE PROCESSING, TARGET DETECTION, CHANGE DETECTION, SITUATION MONITORING

RESSLER ASSOCS INC  
14440 CHERRY LANE CT - STE 212  
LAUREL, MD 20707

Program Manager: ROBERT KATZ

Contract #:

Title: A HELICAL BACKSCATTER MODEL FOR THE EXTRACTION OF POWER LINES FROM POLARIMETRIC SAR IMAGER

Topic #: DARPA90-119

Office:

ID #: 42512

THERE ARE TWO MAIN OBJECTIVES OF THE PHASE I RESEARCH EFFORT. THE FIRST AND OVERALL GOAL IS TO DESIGN A PROGRAM TO DEVELOP AND TEST A SYSTEM WHICH WILL PROVIDE RELIABLE, EFFECTIVE, AND AUTOMATED REMOTE MAPPING OF POWER LINES FOR TACTICAL MISSION PLANNING. THE SECOND GOAL IS TO FACILITATE THE DEVELOPMENT OF AIRBORNE SYSTEMS FOR AIRPLANES AND HELICOPTERS TO ALLOW REAL-TIME IDENTIFICATION OF POWER LINES FOR COLLISION AVOIDANCE. THESE TWO GOALS WILL BE ACCOMPLISHED THROUGH A NEW, HELICAL GEOMETRY FOR MODELING THE RADAR BACKSCATTER FROM POWER LINES. BY UTILIZING POLARIMETRIC SYNTHESIS, THE RADAR SIGNATURE OF THE CABLE CAN BE SIGNIFICANTLY ENHANCED WITH RESPECT TO ITS BACKGROUND. EXISTING DATASET APPROPRIATE FOR TESTING THE NEW WIRE EXTRACTION TECHNIQUE WILL BE IDENTIFIED. IN PHASE II, A SYSTEM FOR PERFORMING THE EXTRACTION WILL BE IMPLEMENTED. THE WIRE LOCATION INFORMATION WILL AUTOMATICALLY BE INTEGRATED WITH COMMERCIAL GEOGRAPHIC INFORMATION SYSTEMS DURING PHASE III. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - POWER LINE COLLISION AVOIDANCE, REMOTE MAPPING OF POWER LINES, IMPROVED SAR DESIGN. KEY WORDS - POLARIMETRY, TRANSMISSION WIRE, SAR, POLARIZATION SYNTHESIS, BACKSCATTER MODEL, RADAR IMAGERY, POWER LINE.

VEXCEL CORP  
2477 - 55TH ST  
BOULDER, CO 80301

Program Manager: MR JOHN THOMAS

Contract #:

Title: DETECTION OF FAINT TARGETS USING A NOVEL 3-D FULLY POLARIZED S...

Topic #: DARPA90-119

Office:

ID #: 42525

VEXCEL CORPORATION PROPOSES A PHASE I RESEARCH EFFORT FOR THE ANALYSIS AND PRELIMINARY SIMULATION OF A NOVEL METHOD FOR DETECTING HIGH-VOLTAGE POWER LINES AND TOWERS IN UNFRIENDLY REGIONS USING MULTIPLE FLIGHT-PATH SYNTHETIC APERTURE RADAR (SAR) IMAGERY. THE PROPOSED METHOD CONSISTS OF ADAPTING THE ESPRIT ALGORITHM FOR ESTIMATION OF ELEVATION ANGLE-OF-ARRIVAL TO SYNTHESIZE A 2-D ARRAY FROM THE MULTIPLE FLIGHT PATHS. THIS APPROACH ALLOWS THE COHERENT ADDITION OF THE LOW RADAR CROSS-SECTION POWER LINE SIGNATURES TO ACCUMULATE COHERENTLY IN A RANGE BIN NOT CONTAINING THE BACKGROUND. THEREFORE, THE DETECTION PROBLEM HAS BEEN EFFECTIVELY TRANSFORMED FROM A VERY DIFFICULT SIGNAL/CLUTTER PROBLEM INTO A SOLUBLE SIGNAL/NOISE PROBLEM. IN ADDITION, THE USE OF POLARIMETRIC QUADPOLE SAR DATA WILL SELECTIVELY ENHANCE THE POWER LINE AND TOWER SIGNATURES. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - AUTOMATED TERRAIN MAPPING, NATURAL RESOURCE MANAGEMENT, TARGET DETECTION AND IDENTIFICATION. KEY WORDS - ELEVATION ANGLE-OF-ARRIVAL,

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**RADAR POLARIMETRY, TARGET DETECTION, TARGET IDENTIFICATION**

IAP RESEARCH INC  
2763 CULVER AVE  
DAYTON, OH 45429  
Program Manager: DAVID BAUER  
Contract #:  
Title: MICRO ACTUATOR SYSTEM DEVELOPMENT FOR PROJECTILE GUIDANCE  
Topic #: DARPA90-120                      Office:                      ID #: 42486

RESEARCH WORK HAS DEMONSTRATED THE FEASIBILITY OF FABRICATING ELECTROMECHANICAL AND MECHANICAL DEVICES IN THE SUBMILLIMETER SIZE RANGE. ARRAYS OF THESE DEVICES, EACH INDEPENDENTLY ACTUATED AND CONTROLLED, HAVE POTENTIAL IN MANY APPLICATIONS REQUIRING PRECISION SURFACE SHAPING OR POSITIONING. THE OBJECTIVE OF THIS PROJECT IS TO DEVELOP MICROACTUATOR SYSTEM USEFUL FOR PROJECTILE FLIGHT CONTROL. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - PROJECTILE ACCURACY AND HIT PROBABILITY WILL BE SIGNIFICANTLY IMPROVED WITH ACTIVE FLIGHT CONTROL PROVIDED BY THE APPROACH. MEDICAL APPLICATIONS REQUIRING PRECISION MINIATURE INSTRUMENTS, AND PRECISION FABRICATION TECHNIQUES SUCH AS FOR INTEGRATED CIRCUITS WILL BENEFIT FROM MICROACTUATOR ARRAY DEVELOPMENT. KEY WORDS - MICROMACHINE, MICROACTUATOR, GUIDANCE

SARCOS RESEARCH CORP  
261 E 300 S - STE 150  
SALT LAKE CITY, UT 84111  
Program Manager: DR FRASER SMITH  
Contract #:  
Title: FET-BASED HYDROPHONE SENSORS  
Topic #: DARPA90-120                      Office:                      ID #: 42514

IN THE COURSE OF THEIR WORK IN MICROSENSORS, MICROACTUATORS, AND ROBOTICS, SRC AND ITS ASSOCIATES HAVE DEVELOPED A NUMBER OF UNIQUE FIELD-BASED SENSORS UTILIZING FIELD EFFECT TRANSISTORS (FETS). BECAUSE THESE SENSORS EXHIBIT HIGH SENSITIVITY AND EXCELLENT LOW FREQUENCY RESPONSE AND AFFORD THE POSSIBILITY OF DIGITAL OUTPUT SIGNALS, THEY OFFER ADVANTAGES OVER CONVENTIONAL PIEZOELECTRIC OR FERROELECTRIC ELEMENTS IN HYDROPHONES, WHICH PRESENTLY HAVE LIMITED LOW-END FREQUENCY RESPONSES WITH ANALOG OUTPUTS. MICROFABRICATION PRINCIPLES CAN BE APPLIED TO MAKE THE PROPOSED FET SENSORS SMALL, RELATIVELY INEXPENSIVE, AND IN LARGE QUANTITIES. THE PROPOSED FET SENSORS CAN ALSO BE NETWORKED INTO VERY LARGE HYDROPHONE ARRAYS VIA MULTIPLEXING CIRCUITRY ON THE FET SENSOR CHIP, ENABLING EFFICIENT DISTRIBUTED SURVEILLANCE THROUGHOUT THE OCEANS. THIS PROPOSAL WILL INVESTIGATE THE SUITABILITY OF FET-BASED MICROSENSORS FOR A NUMBER OF HYDROPHONE-RELATED APPLICATIONS, WITH PARTICULAR ATTENTION TO BANDWIDTHS, SENSITIVITIES AND RESOLUTIONS OF THESE DEVICES. THE PROPOSED PHASE I RESEARCH CONSISTS OF SYSTEM ANALYSIS, PRELIMINARY SENSOR AND PACKAGING DESIGNS, FUNDAMENTAL EXPERIMENTATION, AND FABRICATION PROTOCOLS FOR FET-BASED HYDROPHONE ELEMENTS. FET-BASED HYDROPHONES WOULD OPEN UP AN IMPORTANT APPLICATION AREA IN THE RAPIDLY EXPANDING MICROELECTROMECHANICAL SYSTEMS FIELD, AND WOULD PROVIDE A TECHNOLOGY PUSH AND EDGE IN THE HYDROPHONE AREA SO CRUCIAL TO NAVAL MONITORING EFFORTS. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - BENEFITS: SIGNIFICANTLY ADVANCE THE STATE OF THE ART OF A VERY DEMANDING APPLICATION, NAMELY, HYDROPHONE ACOUSTIC DETECTION SYSTEMS. APPLICATIONS: HIGH SENSITIVITY, HIGH RESOLUTION, ACOUSTIC DETECTION SYSTEMS, INCLUDING HYDROPHONES.

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SAT-CON TECHNOLOGY CORP  
12 EMILY ST

CAMBRIDGE, MA 02139

Program Manager: TIMOTHY HAWKEY

Contract #:

Title: INTEGRATED MICRO-GYROSCOPE

Topic #: DARPA90-120

Office:

ID #: 42515

MICRO-ELECTRONIC FABRICATION TECHNOLOGIES HAVE RECENTLY BEEN APPLIED TO PRODUCE NOVEL MICRO-MECHANICAL DEVICES SUCH AS MOTORS, SENSORS, AND ACTUATORS. THEIR SMALL SIZE AND EASY INTEGRATION WITH MICROELECTRONICS INVITE INNOVATIVE RESEARCH, BUT THUS FAR FEW USEFUL APPLICATION CONCEPTS HAVE BEEN DEVELOPED. ONE DEVICE WITH WIDESPREAD APPLICATION WOULD BE AN ELECTRICALLY SUSPENDED MICRO-GYROSCOPE. THE MOTOR, SENSOR, SUSPENSION, AND CONTROL AND INTERFACE ELECTRONICS COULD BE PACKAGED ON A SINGLE CHIP. THE DEVICES COULD BE PRODUCED FOR LOW COST IN LARGE QUANTITIES AND SEE WIDESPREAD USE IN INTEGRATED NAVIGATION AND CONTROL SYSTEMS FOR VEHICLES, PERSONNEL, OR PROJECTILES. A MICRO-GYROSCOPE MIGHT ALSO MAKE VERY SMALL AUTONOMOUS AIRPLANES, GROUND VEHICLES, OR SATELLITES FOR TERRESTRIAL, PLANETARY, OR SPACE EXPLORATION POSSIBLE. THE FIRST PHASE OF THE PROGRAM WILL INVOLVE DEVELOPMENT OF MICRO- MACHINE DESIGN AND ANALYSIS TOOLS AND THE USE OF THESE TOOLS TO INVESTIGATE POSSIBLE GYROSCOPE CONFIGURATIONS AND THE ESTABLISHMENT OF A BASELINE DESIGN FOR THE MECHANICS, SENSORS, ACTUATORS, AND ELECTRONICS. A PHASE II EFFORT WOULD INCLUDE DETAILED DESIGN, FABRICATION, AND TESTING OF A PROTOTYPE MICRO- GYROSCOPE. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - AN INTEGRATED MICRO-GYROSCOPE WOULD HAVE TREMENDOUS COMMERCIAL AND MILITARY APPLICATION IN MANY GUIDANCE AND CONTROL APPLICATIONS. THE ADVANCEMENT OF MICRO-FABRICATION TECHNOLOGY WOULD ALSO ASSIST THE DEVELOPMENT OF OTHER USEFUL MICRO-DEVICES. KEY WORDS - MICRO-MACHINE, GYROSCOPE, ELECTRIC SUSPENSION.

ATLANTIC AEROSPACE ELECTRONICS CORP  
470 TOTTEN POND RD

WALTHAM, MA 02154

Program Manager: SVEN SPOERRI

Contract #:

Title: ACOUSTIC TARGETING CONCEPT DEVELOPMENT

Topic #: DARPA90-121

Office:

ID #: 42454

THIS PROPOSAL DESCRIBES A NOVEL METHOD FOR TARGETING NOISY, HIGH-VALUE TARGETS SUCH AS ENEMY ARTILLERY, HELICOPTERS AND, PERHAPS, HEAVY VEHICLES AND GENERATORS. THE CONCEPT MAKES USE OF RELATIVELY INEXPENSIVE ACOUSTIC SENSORS WHICH CAN BE DEPLOYED IN ENEMY TERRITORY BY AIR DROP OR BY ARTILLERY. THE SYSTEM LOCATES TARGETS BY CORRELATING THE ACOUSTIC SIGNALS RECEIVED BY SEVERAL PAIRS OF SENSORS TO DETERMINE TIME DIFFERENCE OF ARRIVAL (TDOA). BASIC SIGNAL PROCESSING IS DONE AT EACH SENSOR TO DETERMINE WHETHER THE ACOUSTIC SIGNATURE BEING RECEIVED CORRESPONDS TO A TARGET OF INTEREST IN ORDER TO MINIMIZE COMMUNICATION TO THE CORRELATION ELEMENT (WHICH CAN BE AN UNATTENDED AIR VEHICLE OR A MANNED AIRCRAFT). THIS MINIMIZES SENSOR EXPOSURE TO INTERCEPT. AN INNOVATIVE TECHNIQUE IS DESCRIBED IN THIS PROPOSAL FOR GUIDING A WEAPON TO A TARGET THAT HAS BEEN DETECTED AND CLASSIFIED AS ONE TO BE ENGAGED WITHOUT REQUIRING THAT THE SENSOR LOCATIONS BE EXPLICITLY KNOWN. THIS ELIMINATES THE NEED FOR AUXILIARY METHODS OF DETERMINING SENSOR LOCATIONS AND ALLOWS SENSORS TO BE RAPIDLY DEPLOYED AND UTILIZED. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - THE PROPOSED PHASE I RESEARCH WILL ESTABLISH THE BASIC FEASIBILITY OF THE ACOUSTIC TARGET DETECTION, CLASSIFICATION, LOCATION AND TARGETING CONCEPT. THIS WILL LAY THE GROUNDWORK FOR FURTHER DEVELOPMENT IN PHASE II INCLUDING DETAILED SYSTEM DESIGN AND SIMULATIONS TO ESTABLISH PERFORMANCE. KEY WORDS - ACOUSTIC TARGETING, TDOA, ACOUSTIC SENSORS, WEAPON GUIDANCE, TARGET DETECTION

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DARPA Solicitation 90.2

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ENSCO INC

5400 PORT ROYAL RD  
SPRINGFIELD, VA 22151

Program Manager: ALAN BELL

Contract #:

Title: NEW CONCEPTS FOR DETECTING CLASSIFYING OR LOCATING MOBILE OBJECTS USING LOW COST ACOUSTIC SENSORS

Topic #: DARPA90-121

Office:

ID #: 42473

OUR PROPOSAL EFFORT DEFINES AN APPROACH TO DEVELOPING A FAMILY OF LOW-COST EXPENDABLE ATMOSPHERIC ACOUSTIC SENSORS. DURING PHASE I WE PROPOSE TO IDENTIFY THE HARDWARE COMPONENTS AND ON-BOARD PROCESSING REQUIREMENTS FOR AN ADVANCED ACOUSTIC SENSOR PACKAGE. OUR GOAL IS TO DEFINE A PACKAGE THAT MAY BE READILY DEPLOYED TO A REMOTE SITE, EITHER BY AIRBORNE MEANS OR BY A SINGLE INDIVIDUAL TRAVELLING ON FOOT. THE SENSOR PACKAGE SHOULD BE SELF-POWERED WITH SUFFICIENT BATTERY RESERVE TO SUPPORT OPERATION FOR PERIOD SPANNING AS MUCH AS SEVERAL WEEKS. THE SENSOR PACKAGE SHOULD ALSO BE SUFFICIENTLY RUGGED ALLOW DEPLOYMENT IN ALL TYPES OF TERRAIN AND SHOULD BE OPERABLE IN AN EXPOSED ENVIRONMENT POSSIBLY SUBJECT TO EXTREMES OF BOTH TEMPERATURE AND MOISTURE. VARIOUS SYSTEM CONFIGURATIONS WILL BE EXAMINED, INCLUDING SIGNAL SENSOR UNITS, DISTRIBUTED MULTISENSOR ARRAYS, AND VARIOUS HYBRID PACKAGES WHICH INCLUDE OTHER SENSOR TYPES (I.E., SEISMIC, MAGNETIC, PYROELECTRIC, AND OPTICAL). A PRELIMINARY DESIGN CONCEPT WILL BE DEVELOPED TO SERVE AS THE BASIS OF PHASE II EFFORTS. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - THIS EFFORT WILL BENEFIT THE FEDERAL GOVT. BY PROVIDING THE MILITARY AND OTHER GOVT. AGENCIES WITH AN EFFECTIVE INTELLIGENCE GATHERING AND UNIT SECURITY CAPABILITY. THIS CAPABILITY WILL BE OF USE TO BOTH GOVERNMENT AGENCIES AND CIVILIAN LAW ENFORCEMENT ORGANIZATIONS. THIS EFFORT WILL ALSO PROVIDE POTENTIAL COMMERCIAL APPLICATIONS IN THE AREA OF PERIMETER AND FACILITES SECURITY OF COMMERCIAL INSTALLATIONS. KEY WORDS - ACOUSTIC SENSORS, TARGET DETECTION, TARGET LOCATION, TARGET CLASSIFICATION, LOW INTENSITY CONFLICT, SPECIAL OPERATIONS

GENISYS RESEARCH & DEVELOPMENT INC

201 MILL ST  
ROME, NY 13440

Program Manager: THOMAS EDWARDS

Contract #:

Title: PARALLEL PROCESSING ALGORITHMS FOR REAL-TIME SIMULATION

Topic #: DARPA90-122

Office:

ID #: 42483

THE NATURE OF EW/C3CM CALCULATIONS LENDS ITSELF TO A PARALLEL PROCESSING APPROACH FOR REAL-TIME COMPUTATIONS. EFFECTIVE PARALLEL PROCESSING, HOWEVER, INTRODUCES ADDITIONAL COMPLEXITIES OF LOAD LEVELING BETWEEN PROCESSING RESOURCES, PROCESSOR CONTROL AND SYNCHRONIZATION, AND MANAGEMENT OF THE "AREA OF FOCUS" SUCH THAT THE SIMULATION PERFORMED IS DYNAMICALLY SCALABLE IN THE LEVEL OF DETAIL CONSIDERED AND COORDINATED TO PROVIDE REAL-TIME RESPONSE. IN THIS PROPOSAL, WE ADVANCE A METHODOLOGY AND ARCHITECTURE FOR HIGHLY EFFICIENT REAL-TIME PARALLEL PROCESSING WHICH EXPLOITS THE SPACIAL RELATIONSHIPS BETWEEN THE ITEMS BEING SUMULATED. PROCESSING ELEMENTS OF A PARALLEL ENVIRONMENT ARE ASSIGNED 3-DIMENSIONAL GEOGRAPHIC AREAS OF RESPONSIBILITY. "LOAD BALANCING" IS ACCOMPLISHED BY MODIFYING EACH NODES GEOGRAPHIC AREA OF RESPONSIBILITY. UNIQUELY THE MANAGEMENT OF THE NODE ASSIGNED AREAS IS DE-CENTRALIZED, THE LOCAL NODE DETERMINING CONJESTION AND NEGOTIATING AREA TRANSACTIONS WITH ITS NEIGHBORING NODES. THIS ROBUST DE-CENTRALIZED LOAD-BALANCING IN TURN ALLOWS THE SIMULATION FIDELITY TO BE CONTROLLED DYNAMICALLY AT THE OBJECT LEVEL WHILE MAINTAINING REAL-TIME RESPONSE. THE PROPOSED ARCHITECTURE FREE FROM BUS OR SHARED MEMORY LIMITATIONS IS IMPLEMENTABLE TO CURRENT TRANSPUTER TECHNOLOGY

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TO PROVIDE COST EFFECTIVE MASSIVELY-PARALLEL REAL-TIME SIMULATION. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - THE PROPOSED METHODOLOGY WILL VASTLY EXTEND THE DEGREE OF PARALLELISM PRACTICALLY ACHIEVABLE BY LARGE-SCALE SIMULATION AND CERTAIN CLASSES OF MATHEMATICAL MODELING INCLUDING FINITE ELEMENT ANALYSIS. THE ALGORITHMS ADVANCED MAINTAIN REAL-TIME RESPONSE THROUGH A COMBINATION OF ROBUST LOAD-BALANCING ACCOMODATING TRANSIENT IN PROCESSING NODE LOADING.

**FRYDENLUND T APPLIED TECHNOLOGIES**

1960 ALDEN ST  
BELMONT, CA 94002

Program Manager: DAVID FRYDENLUND

Contract #:

Title: KNOWLEDGE BASED TOOLS FOR FASTER THAN REAL-TIME EPISODIC CHAMPAIGN PLANNING FOR COMPREHENSIVELY...

Topic #: DARPA90-123

Office:

ID #: 42521

THIS PROJECT IS AN EXPLORATION OF THE APPLICATION OF KNOWLEDGE BASED TOOLS TO SCALABLE MILITARY CAMPAIGN SIMULATIONS. THE APPROACH TO BE TAKEN IS TO DEVELOP A GENERALIZED FRAME BASED KNOWLEDGE REPRESENTATION SYSTEM WITH A COMBINATION OF ACTIVE AND STATIC SLOT VALUES TO REPRESENT THE CHARACTERISTICS OF EACH LEVEL OF THE FORCE HIERARCHY. ACTIVE VALUES IN THE SYSTEM MAY CONSIST OF DATA BASE QUERIES, PROCEDURAL (DETERMINISTIC) PROGRAM CALLS, OR NON-PROCEDURAL (INFERENCE ENGINE) CALLS. AGGREGATION IS ACCOMODATED THROUGH ALGORITHMS CALLED BY THE ACTIVE VALUE SLOTS OF THE FRAME. OPPOSING FORCE ACTIVITIES ARE SIMILARLY SIMULATED FOR PLAY AGAINST THE COMPUTER. PROGRAMMING A SIMULATION IS TABLE DRIVEN AND WILL BE ACCOMPLISHED BY CHANGING THE SLOT VALUES IN THE CONTROLLING FRAME(S) OF THE INSTANTIATION. SYSTEM PERFORMANCE IS BROUGHT TO FASTER THAN REAL TIME BY USING A MODIFICATION OF A PROPRIETARY, SCALABLE, DISTRIBUTED, PARALLEL-PROCESSING SYSTEM RUNNING ON A NETWORK OF PERSONAL COMPUTERS. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - THE KNOWLEDGE REPRESENTATION SCHEME TO BE DEVELOPED SHOULD BE OF VALUE FOR ANY HIERARCHICALLY ORIENTED SIMULATION (ESPECIALLY FOR MILITARY, BUSINESS, OR GOVERNMENTAL UNIT INTERACTIONS). THE MODIFIED PARALLEL PROCESSING SYSTEM WILL MAKE POSSIBLE MUCH CHEAPER AND MORE ROBUST SCALABLE, FAULT-TOLERANT COMPUTING SYSEMS. KEY WORDS - KNOWLEDGE REPRESENTATION, KNOWLEDGE BASED TOOLS, PARALLEL PROCESSING SYSTEM, FORCE HIERARCHY

**CARD & ASSOCS - RSCH & DEVEL**

BOX 153 RD 1/NEWPORT RD  
UTICA, NY 13502

Program Manager: STUART CARD

Contract #:

Title: ARTIFICIAL NEURAL NETWORK TARGET RECOGNITION DEMONSTRATION

Topic #: DARPA90-124

Office:

ID #: 42459

INNOVATIVE, REAL-TIME, NEURAL NETWORK HARDWARE TECHNIQUES FOR IMPLEMENTING DR. JOHNSON'S DYNAMIC OBJECT EXTRACTION PREPROCESSOR ALGORITHM FOR AUTOMATIC TARGET RECOGNITION WILL BE INVESTIGATED, DEVELOPED AND DEMONSTRATED. SCALABILITY TO FULL REAL-TIME 2-DIMENSIONAL IMAGERY WILL BE SHOWN. THE FEASIBILITY OF DEVELOPING A PHASE II HARDWARE PROTOTYPE FOR ALGORITHM VALIDATION AND PERFORMANCE MEASUREMENT, AND OF DEVELOPING A PHASE III OPERATIONAL SYSTEM WILL BE ESTIMATED. THIS PROBLEM WILL BE ADDRESSED BY INNOVATIVE APPLICATION OF NEW DEVICES PROVIDING ON CHIP PARALLELISM. FOUR TECHNICAL OBJECTIVES SHOULD ADEQUATELY DEMONSTRATE THE FEASIBILITY OF PERFORMING ATR PREPROCESSING WITH HARDWARE IMPLEMENTATION OF THIS ALGORITHM: 1. CANDIDATE DEVICES AVAILABLE NOW OR IN THE NEAR FUTURE WILL BE EVALUATED FOR SUITABILITY; 2. THE MOST SUITABLE WILL BE USED AS BASIS FOR THE



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DETAILED BLOCK DIAGRAM OF A CONCEPTUAL DESIGN, PERMITTING GENERAL CONNECTIVITY WITHIN A NEIGHBORHOOD OF THE CELL OF INTEREST IN NEURAL NET FASHION; 3. THE DESIGN WILL BE SIMULATED IN SOFTWARE; 4. THE ANALYSIS AND SIMULATION RESULTS WILL BE FED BACK TO IMPROVE THE DESIGN. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - ATR IS RECOGNIZED BY DOD AS A CRITICAL NEED, PARTICULARLY IN THE DEVELOPMENT OF "BRILLIANT WEAPONS". POTENTIAL CIVILIAN APPLICATIONS INCLUDE LAW ENFORCEMENT, COLLISION AND TRAFFIC MANAGEMENT, FACTORY AUTOMATION AND ENABLING TECHNOLOGY FOR THE HANDICAPPED. EXPERTISE WILL BE DEVELOPED IN THE DESIGN, PROGRAMMING, INTERFACING AND SCALING OF MASSIVELY PARALLEL PROCESSORS AND NEURAL NETWORKS. KEY WORDS - AUTOMATIC TARGET RECOGNITION, ATR, OBJECT EXTRACTION,

LASER SCIENCE INC  
26 LANDSDOWNE ST  
CAMBRIDGE, MA 02139  
Program Manager: LAWRENCE BERG  
Contract #:  
Title: WIDE DYNAMIC RANGE LASER DIODES FOR COMMUNICATIONS  
Topic #: DARPA90-126                      Office:                      ID #: 42494

WITH THE ADVENT OF LASERS IN COMMUNICATIONS, ONE TECHNIQUE THAT IS EMPLOYED IS DIRECT AMPLITUDE MODULATION OF THE SOURCE LASER WITH THE RF WAVE THAT ACTUALLY CARRIES THE INFORMATION OF INTEREST. DEMODULATION IS PERFORMED VIA DIRECT DETECTION OF THE RECEIVED BEAM FOR MANY SHORT-DISTANT COMMUNICATIONS. A LIMITATION ON THIS TECHNIQUE IS THE LINEARITY OF THE DIRECT MODULATION. THAT IS, THE AMPLITUDE OF THE OPTICAL CARRIER DOES NOT CORRESPOND TO THE AMPLITUDE OF THE INPUT RF IN A LINEAR FASHION. THIS NONLINEARITY CAN CAUSE DISTORTIONS, ESPECIALLY WHEN MANY CHANNELS ARE MULTIPLEXED IN THE RF PRIOR TO MODULATION. ONE METHOD TO CORRECT THIS PROBLEM IS A LASER DIODE DEVELOPMENT EFFORT TO CREATE DIODES WITH THE APPROPRIATE LINEARITY (1 PART IN 10,000). THIS, HOWEVER, CAN BE VERY COSTLY AND CAN DELAY THIS COMMUNICATION TECHNOLOGY FROM FUTURE DEVELOPMENT. A MORE COST-EFFECTIVE CORRECTION IS TO USE PRESENT TECHNOLOGY IN DIODE DEVELOPMENT AND CREATE THE NECESSARY LINEARITY THROUGH ELECTRONIC FEEDBACK. SCIENCE, INC. PROPOSES THIS APPROACH, BASED ON TECHNOLOGY RELATED TO THE STABILITY OF LASER POWER OUTPUT. THIS PROPOSAL DISCUSSES A NOVEL METHOD WHEREBY COMMERCIALY-AVAILABLE ELECTRO-OPTIC COMPONENTS CAN BE PACKAGED TO PRODUCE THE EFFECTS OF A LASER DIODE WITH OUTPUT LINEARITY OF 1 PART IN 10,000 AND A BANDWIDTH OF 10 MHZ. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - APPROPRIATE ELECTRO-OPTIC TECHNOLOGY ALONG WITH ELECTRONIC FEEDBACK OR FEEDFORWARD NETWORKS CAN PRODUCE THE APPROPRIATE MODULATION LINEARITY WITHOUT THE NEED FOR EXPENSIVE LASER DIODE DEVELOPMENT WORK. THEREFORE, THIS TECHNOLOGY WILL PROVIDE A COST-EFFECTIVE METHOD FOR CREATING FIBER OPTIC COMMUNICATION LINKS USING DIRECT DETECTION

ACTIVE TECHNOLOGIES INC  
1117 LAVELLE RD - STE B  
ALAMOGORDO, NM 88310  
Program Manager: HAROLD SCOTT  
Contract #:  
Title: GENERATORS (ELECTROMECHANICAL POWER SUPPLIED) FOR MINIATURE RECIPROCATING ENGINES (MODEL AIRCRAFT ...)  
Topic #: DARPA90-127                      Office:                      ID #: 42448

FOUR BEARINGLESS, SHAFT MOUNTED GENERATORS WITH OUTPUTS OF 10, 100, 500 AND 1000 WATTS OF 12-15 V DC WILL BE DESIGNED AND COMPUTER MODELED TO BE DRIVEN BY MODEL AIRPLANE SIZE RECIPROCATING ENGINES. DESIGN COMBINATIONS OF IRONLESS DISK AND IRON LAMINATION CYLINDRICAL GENERATORS USING RARE EARTH AND CERAMIC PERMANENT MAGNETS WILL BE MODELED

SMALL BUSINESS INNOVATION RESEARCH PROGRAM - PHASE I  
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FOR RELIABILITY WITH THE LOWEST WEIGHT AT THE HIGHEST EFFICIENCY RELATED TO ESTIMATED MATERIAL COST OF PRODUCTION MODELS. PROPRIETARY HIGH PERFORMANCE GENERATOR DESIGN SOFTWARE PREVIOUSLY WRITTEN BY THE PI (PRINCIPLE INVESTIGATOR) WILL BE MODIFIED TO OPTIMIZE THE DESIGN AND OPERATION OF THESE GENERATORS. A NUMBER OF HIGH PERFORMANCE GENERATORS, INCLUDING A 500 WATT GENERATOR DRIVEN BY A 2CC ENGINE HAVE BEEN DESIGNED, BUILT AND TESTED FOR INDUSTRIAL APPLICATIONS WITH THE ASSISTANCE OF THIS SOFTWARE. AS GENERATOR WEIGHT IS REDUCED, EFFICIENCY DROPS AND MORE FUEL IS REQUIRED PER FLIGHT MISSION. AN OPERATING MODEL WILL BE WRITTEN TO OPTIMIZE TOTAL MISSION WEIGHT AND MAINTAINABILITY. A 10 WATT PROTOTYPE (OR AS SPECIFIED) WILL BE BUILT AND TESTED TO COMPARE PERFORMANCE WITH THE COMPUTER DESIGNED MODEL FOR RPM VS OUTPUT, EFFICIENCY AND WEIGHT. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - THE LIGHTWEIGHT GENERATOR WILL PROVIDE ON-BOARD ELECTRICAL POWER TO ENABLE LONG DURATION FLIGHTS OF VERY SMALL AIRCRAFT. USES INCLUDE SERVEILANCE, AERIAL MAPPING, EXPENDABLE FLIGHTS INTO HAZARDOUS SITUATIONS AND LOW COST RELAY PLATFORMS. THE MINIATURE ENGINE DRIVEN GENERATOR PROVIDES THE BASIS FOR VERY SMALL PORTABLE GENERATOR SETS. A QUART SIZE GEN SET WOULD PRODUCE 500 WATTS FOR EMERGENCY LIGHTING OR REMOTE CAR OR TRUCK STARTING IN THE WINTER.

COMPUDRIVE CORP  
49 RIVER ST  
MAYNARD, MA 01754  
Program Manager: SIDNEY DAVIS  
Contract #:  
Title: GENERATORS FOR MINIATURE RECIPROCATING ENGINES 1W TO 1KW  
Topic #: DARPA90-127                      Office:                      ID #: 42464

A POWER SUPPLY SYSTEM USING A MODEL AIRPLANE TYPE GASOLINE ENGINE DRIVING A POLYPHASE ELECTRICAL ALTERNATOR FOLLOWED BY AN ELECTRONIC RECTIFIER AND REGULATOR IS PROPOSED. THE OFFERED UNIT WILL DELIVER ABOUT 100 WATTS OF HIGH QUALITY DC POWER IN THE 12-15 VDC RANGE. THE GENERATOR WILL BE DESIGNED, CONSISTENT WITH A THEORY OF OPTIMIZATION AS DESCRIBED IN THE PROPOSAL, FOR MAXIMUM RELIABLE OUTPUT FOR A GIVEN PACKAGE ENVELOPE AND WEIGHT. OPTIMIZATION EQUATIONS, UNIFORMLY APPLICABLE TO THE RANGE OF 1 TO 1000 WATTS POWER OUTPUT AS A FUNCTION OF PRIME MOVER SPEED, WILL BE DEVELOPED. THE DESIGN FORMULA, DEMONSTRATED AND VERIFIED IN THE PROPOSED 100 WATT MODEL, WILL BE UNIVERSALLY APPLICABLE TO THE RANGE OF VARIATIONS. THE PROGRAM WILL INCLUDE A BREADBOARD TEST SET AND FULL TEST RESULTS IN A FINAL REPORT. IN CONTEXT OF DUTY CYCLE AND THERMAL CONSIDERATIONS AS THE DESIGN DRIVERS, THE PROPOSED REPORT WILL INCLUDE PRACTICAL GUIDELINES. A TECHNICAL SUPPLEMENT TO THE PROPOSAL PROVIDES BENCHMARK PARAMETERS AGAINST WHICH TO MEASURE PERFORMANCE. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - MULTIPLE APPLICATIONS FOR A LIGHT WEIGHT, RUGGED AND RELIABLE LOW POWER DC ELECTROMECHANICAL GENERATOR. KEY WORDS - LIGHT, WEIGHT, RUGGED, RELIABLE, DC, ELECTROMECHANICAL, POWER, SUPPLY

ENCOTECH INC  
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Program Manager: MICHAEL MONTGOMERY  
Contract #:  
Title: GENERATORS (ELECTROMECHANICAL POWER SUPPLIES) FOR MINIATURE RECIPROCATING ENGINES (MODEL AIRCRAFT ...)  
Topic #: DARPA90-127                      Office:                      ID #: 42472

THE REQUIREMENTS FOR RUGGEDNESS, HIGH RELIABILITY, AND SCALABILITY IN A LOW POWER ELECTROMECHANICAL POWER SUPPLY WERE THE SELECTION CRITERIA USED IN CHOOSING THE HIDRIVE

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ADJUSTABLE SPEED MOTOR DESIGN FOR ADAPTATION TO OPERATION AS A GENERATOR AND FOR EXPLORATORY DEVELOPMENT DOWN TO THE SIZE RANGE REQUIRED TO ADDRESS DARPA'S NEEDS. WITH HIDRIVE, THE MOTOR SHAFT IS SOLID AND HAS NO WINDINGS OR LAMINATIONS. THIS PERMITS SCALING FOR OPERATION AT VERY HIGH SPEEDS (THE PHASE I DEMONSTRATION IS TO BE AT 28,000 RPM), RESULTING IN A HIGH POWER DENSITY AND EFFICIENCY WHILE OFFERING RUGGEDNESS AND SMOOTH OPERATION, DESIREABLE QUALITIES FOR AIRBORNE APPLICATIONS. THE HIGH FREQUENCY POWER GENERATED PERMITS CONVERSION TO A VERY SMOOTH DC VOLTAGE OUTPUT. ALL LAMINATIONS AND WINDINGS ARE STATIONARY AND NO BRUSHES ARE USED, THEREBY ELIMINATING TRADITIONAL MECHANICAL INTEGRITY PROBLEMS DUE TO DYNAMIC FORCES. ENCOTECH, INC. PROPOSED TO ADAPT A HIDRIVE SYSTEM SCALED TO PRODUCE 10 WATTS OF 12-15 VDC ELECTRIC POWER WHEN DRIVEN BY A MODEL AIRPLANE ENGINE. THE PHASE I EFFORT WILL BE TO PRODUCE A DEMONSTRATION BENCH TEST RIG. PHASE II ACTIVITIES WILL ADDRESS THE DESIGN AND MANUFACTURE OF TWO DIFFERENT SIZE FLYABLE PROTOTYPE SYSTEMS TO DEMONSTRATE BOTH THE SOUNDNESS OF THE DESIGN AND ITS SCALABILITY. DARPA OR APPROPRIATE OTHER AGENCY INTENDED MISSION EQUIVALENT SPECIFICATIONS ARE TO BE ESTABLISHED AND MET. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - THE FLEXIBILITY AND ADAPTABILITY OF THE HIDRIVE DESIGN CONCEPT PERMITS ITS USE AS BOTH ELEMENTS OF A LONG-DURATION MOTOR-GENERATOR SET. IT ALSO MAY BE USED AS A SOURCE OF GENERATION OF ELECTRIC POWER HAVING UNUSUAL OR SPECIAL CHARACTERISTICS. IT IS APPLICABLE TO AIRCRAFT, SONOBOUYS, DRONES, SURVEILLANCE VEHICLES, OR OTHER SIMILAR REMOTE OR HOSTILE APPLICATIONS IN A WIDE RANGE OF SIZES.

FOSTER-MILLER INC

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WALTHAM, MA 02154

Program Manager: JEFFERY GOLDMAN

Contract #:

Title: MINIATURE BRUSHLESS ALTERNATORS

Topic #: DARPA90-127

Office:

ID #: 42477

A BRUSHLESS ALTERNATOR USING VERY HIGH ENERGY PRODUCT PERMANENT MAGNETS WILL BE COMBINED WITH HIGH EFFICIENCY SOLID-STATE VOLTAGE CONVERSION TECHNOLOGY TO DEMONSTRATE PRECISE ELECTRICAL POWER GENERATION FOR ELECTRONICS ONBOARD MINIATURE AIRCRAFT. PHASE I WILL INCLUDE DESIGN OPTIMIZATION, FABRICATION, AND TESTING OF A PROTOTYPE ALTERNATOR, CONCLUDING WITH A DEMONSTRATION OF THE PROTOTYPE DRIVEN BY A 1.5 HP, JP-8 FUELED ENGINE DEVELOPED BY FOSTER-MILLER. THE PHASE I EFFORT WILL TARGET THE MORE DIFFICULT, LOW POWER END OF THE RANGE OF INTEREST: A LOW POWER OUTPUT WITH 84 PERCENT ALTERNATOR EFFICIENCY FROM 0.16 LB OF ELECTROMAGNETIC WEIGHT. PRECISE VOLTAGE REGULATION WILL BE OBTAINED USING TECHNOLOGY DERIVED FROM COMPUTER POWER CONDITIONING MODULES AVAILABLE FOR APPLICATIONS RANGING FROM JUST A FEW WATTS TO OVER A KILOWATT. FOR THE LOW APPLICATION, A LONG-TERM GOAL OF 87 PERCENT REGULATION EFFICIENCY IS ANTICIPATED WITH A SOLID-STATE REGULATOR WEIGHT BELOW 0.10 LB, DELIVERING STABLE, HIGH QUALITY DC ELECTRIC POWER INDEPENDENT OF ENGINE SPEED. FOSTER-MILLER WILL DESIGN, BUILD, AND TEST THE ALTERNATOR AND ELECTRONICS. THE ELECTROMAGNETIC DESIGN WILL BE PERFORMED BY OUR CONSULTANT, ANDREW DRUZSBA, AN ENGINEER WITH THE AIR RESEARCH DIVISION OF ALLIED-SIGNAL, WHO HAS BEEN INVOLVED IN THE DEVELOPMENT OF ADVANCED MOTORS AND GENERATORS FOR THE AEROSPACE INDUSTRY SINCE 1973. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - THE TECHNOLOGY RESULTING FROM THE PROPOSED PROGRAM WILL RESULT IN A FAMILY OF ADVANCED, LIGHTWEIGHT GENERATORS FOR MINIATURE AIRCRAFT. THIS TECHNOLOGY WOULD BE EQUALLY APPLICABLE TO THE DEVELOPMENT OF LIGHTWEIGHT, EFFICIENT PORTABLE GENERATOR SETS FOR MILITARY AND COMMERCIAL APPLICATIONS. KEY WORDS - MOTORS, MINIATURE AIRCRAFT, GENERATOR, PERMANENT MAGNET, ALTERNATORS, BRUSHLESS, POWER REGULATION.

INTER-SCIENCE INC

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**DARPA Solicitation 90.2**

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105 JORDAN RD  
TROY, NY 12180

Program Manager: MICHAEL AMPELA

Contract #:

Title: A COMPACT LIGHTWEIGHT AND RUGGED VOLTAGE MULTIPLIED HOMOPOLAR GENERATOR FOR RELIABLE HIGH SPEED ...

Topic #: DARPA90-127

Office:

ID #: 42489

AS ELECTRONICS BECOME SMALLER THROUGH MINIATURIZATION, THE ABILITY TO FLY ELECTRONIC PACKAGES OVER LARGE DISTANCES IS BECOMING MORE LIMITED BY THE LACK OF GENERATORS DESIGNED TO OPERATE IN THE LOW POWER, HIGH RPM RANGE. IN RESPONSE TO THIS PROBLEM, A PROGRAM TO DEVELOP A VOLTAGE MULTIPLIED HOMOPOLAR GENERATOR (VMHPG) IS PROPOSED. THE SYSTEM IS BASED ON THE WELL KNOWN HOMOPOLAR GENERATOR PRINCIPLE AND FEATURES A UNIQUE VOLTAGE MULTIPLYING ARMATURE MAKING THE DESIGN SIMPLE, COMPACT, AND LIGHTWEIGHT SUCH THAT IT IS WELL SUITED FOR THE DARPA APPLICATION. THE VMHPG CONSISTS OF A THIN ROTATING DISK ARMATURE IMMERSED IN A MULTIPOLE MAGNET STRUCTURE. REVOLUTIONARY DEVELOPMENTS IN PERMANENT MAGNET TECHNOLOGY HAVE MADE IT POSSIBLE TO DEVELOP AN EFFECTIVE REPLACEMENT FOR THE BULKY FIELD COILS FOUND IN STANDARD GENERATORS, AND THROUGH PROPER SELECTION OF GEOMETRY, IMPROVED POWER DENSITIES ARE ATTAINABLE. THE PROPOSED DESIGN OFFERS EXTREMELY LOW GYROSCOPIC EFFECTS WHILE PROVIDING INCREASING POWER DENSITIES AT HIGHER RPMs. IN ADDITION, SINCE THE DESIGN IS BASED ON THE CONVENTIONAL HOMOPOLAR GENERATOR CONCEPT, THE FINAL PRODUCT WILL BE A SIMPLE, RUGGED ASSEMBLY THAT CAN BE MASS PRODUCED AT LOW COST. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - THE DEVELOPMENT OF AN EFFICIENT ELECTROMECHANICAL POWER SUPPLY DESIGNED FOR THE HIGHER RPM RANGE WILL EXTEND THE OPTIONS FOR POWERING ELECTRONIC PACKAGES ON SMALL FLIGHT VEHICLES CURRENTLY LIMITED BY BULKY BATTERY PACKS. A PROGRAM TO DEVELOP A VOLTAGE MULTIPLIED HOMOPOLAR GENERATOR DESIGNED TO SATISFY THE DARPA APPLICATION WILL CAPTURE A SIGNIFICANT PORTION OF THE PORTABLE GENERATOR MARKET INCLUDING THE AUTOMOTIVE SECTOR. KEY WORDS - ELECTROMECHANICAL, PORTABLE, ELECTRICAL GENERATOR, POWER SUPPLIES, HOMOPOLAR GENERATOR

KINETIC SYSTEMS

26240 INDUSTRIAL BLVD

HAYWARD, CA 94545

Program Manager: C O'NEILL

Contract #:

Title: GENERATORS FOR MINIATURE RECIPROCATING ENGINES WITH SUSTAINED POWER LEVELS FROM 1 WATT TO 1 KW

Topic #: DARPA90-127

Office:

ID #: 42493

A SOLID STATE GENERATOR IS PROPOSED THAT EMPLOYS A PULSATILE HYDRAULIC OUTPUT CYCLICALLY TO STRESS A STACK OF FERROELECTRIC ELEMENTS. THE HYDRAULIC ENERGY IS CONVERTED TO ELECTRICAL ENERGY IN THE FERROELECTRIC MATERIAL AND THE OUTPUT IS TRANSFORMED FROM RELATIVELY HIGH TO LOW VOLTAGE SUBSEQUENTLY TO BE RECTIFIED AND CAPACITIVELY STORED. THE PULSATILE HYDRAULIC OUTPUT IS DERIVED FROM A SMALLECCENTRIC DRIVING A SCOTCH CRANK THAT INTRUDES A PLUNGER INTO A CLOSED OIL VOLUME. THE SYSTEM PROPOSED TO BE FABRICATED AND TESTED IN PHASE I WILL GENERATE 8.4W WITH AN EFFICIENCY OF 38%. THE ECCENTRICITY OF THE DRIVING CRANK FOR SYSTEM IS ONLY 0.005 INCH. A DESIGN IS PRESENTED THAT SHOWS FEASIBILITY FOR A 112W GENERATOR, WITH SIMILAR EFFICIENCY, THAT CAN BE DRIVEN BY A MODEL AEROPLANE I.C. ENGINE FOR DEVELOPMENT IN PHASE II. THIS TYPE OF GENERATOR IS NEITHER SENSITIVE TO NOR PRODUCES MAGNETIC FIELD. IT ADDS NOTHING TO THE GYROSCOPIC COUPLE OF THE POWER PLANT BECAUSE IT ADDS NO ROTATING INERTIA. FERROELECTRIC MATERIALS ARE VERY INERT, RESISTANT TO ENVIRONMENTAL EXTREMES AND CORROSIVE ATTACK. THEY HAVE BEEN TESTED TO VERY HIGH LEVELS OF SHOCK, VIBRATION AND RADIATION. KINETIC SYSTEMS PERSONNEL HAVE BEEN DEVELOPING FERROELECTRIC MATERIALS AND APPLICATIONS FOR OVER 22 YEARS. ANTICIPATED BENEFITS/POTENTIAL

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COMMERCIAL APPLICATIONS - MINIATURE LIGHTWEIGHT POWER SUPPLIES OF LOW TO HIGH VOLTAGE OUTPUT CAN HAVE MANY BENEFITS IN MISSILES, SPACE VEHICLES, PILOTLESS AIRCRAFT OR AS SATELLITE GENERATORS TAKING ADVANTAGE OF PULSATILE ENERGY EITHER HYDRAULIC, GAS PRESSURE OR MECHANICAL VIBRATIONS.

E-TEK DYNAMICS INC  
1885 LUNDY AVE  
SAN JOSE, CA 95131

Program Manager: J PAN

Contract #:

Title: PASSIVE SENSORS FOR APPLICATION TO LOW OBSERVABLE AIRCRAFT

Topic #: DARPA90-128

Office:

ID #: 42469

IN PHASE I, E-TEK WILL ANALYZE, DESIGN AND OPTIMIZE AN INNOVATIVE PASSIVE MAGNETIC SENSING SYSTEM TO DETECT LOW OBSERVABLE AIRCRAFT. THIS INNOVATIVE MAGNETIC SENSING SYSTEM PROVIDES <10 X-13 GAUSS SENSITIVITY, GREATER THAN 4 GHZ FREQUENCY RESPONSE, LESS THAN 0.1%/DEGREE THERMAL STABILITY, EXCELLENT ABILITY TO RESIST WEATHER/ELECTRICAL, VEHICLE INTERFERENCE/IMMUNITY TO LASER/MICROWAVE RADIATION. WITH E-TEK'S MANY YEARS OF EXPERIENCE IN DEVELOPING INTEGRATED OPTICAL DEVICES, NONLINEAR MAGNETIC-OPTIC MATERIALS, HIGH FREQUENCY MODULATORS, COMPUTER-AIDED MODELING AND SOPHISTICATED PACKAGE DESIGN, PHASE I INVESTIGATION WILL LEAD DIRECTLY AND SMOOTHLY TO PHASE II HARDWARE IMPLEMENTATION, EVALUATION AND DEMONSTRATION. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - 1. ANTENNA NEAR AND FAR FIELD MEASUREMENTS 2. EARTHQUAKE DETECTION 3. OIL PROSPECTING 4. BIOMAGNETIC FIELD DETECTION 5. ELECTRICAL INTELLIGENCE KEY WORDS - HIGH-SENSITIVITY, MAGNETIC, SENSOR, LOW-OBSERVABLE, AIRCRAFT, DETECTING

OPHIR CORP  
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LAKEWOOD, CO 80227  
Program Manager: DR LOREN NELSON

Contract #:

Title: A NOVEL PASSIVE SENSOR FOR APPLICATION TO LOW OBSERVABLE TARGETS

Topic #: DARPA90-128

Office:

ID #: 42501

WE PROPOSE A UNIQUE METHOD TO DETECT BOTH CONVENTIONAL AND LOW-OBSERVABLE AIRCRAFT AND MISSILES. THE METHOD RELIES ON NONE OF THE TYPICALLY USED SIGNATURES (I.E., THERMAL, RADAR, ELECTRONIC, VISUAL, AUDIO, OR CONTRAIL) AND THUS WOULD BE IMMUNE TO ALL THE PRESENTLY EXISTING DECOYS AND COUNTERMEASURES. THE SENSOR SPECIFICALLY DETECTS AND MEASURES THE RELATIVE CONCENTRATION AND CHEMICAL SIGNATURE OF FUEL COMBUSTION PRODUCTS. SINCE ALL TARGETS WHICH RELY ON ENGINES FOR PROPULSION MUST COMBUST FUEL, THIS SENSOR CANNOT BE EASILY DECOYED AND WOULD BE VERY EFFECTIVE AGAINST LOW-OBSERVABLE TARGETS. THE SENSOR IS PASSIVE AND THUS NOT ITSELF OBSERVABLE OR DIRECTLY JAMMABLE DURING ITS DETECTING/TARGETING OPERATION. IT COULD BE ADAPTED TO FUNCTION AS A SIMPLE TARGET GUIDANCE SENSOR, OR INCORPORATED INTO SCANNING SYSTEMS TO SUPPLEMENT ACTIVE RADAR FOR THE DETECTION OF LOW-OBSERVABLE TARGETS. THE SENSOR COULD BE USED IN AIRBORNE, GROUND AND SPACEBORNE APPLICATIONS. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - THE SENSOR HAS TWO MAJOR ANTICIPATED BENEFITS. FIRST, IT CAN BE USED AS A PASSIVE DECOY-RESISTANT SENSOR FOR MISSILE GUIDANCE, REPLACING THE PRESENT COMMON HEAT-SEEKING TECHNOLOGY. SECONDLY, IF INCORPORATED INTO AN IMAGING SYSTEM, IT HAS POTENTIAL TO AUGMENT OTHER SURVEILLANCE SYSTEMS, ENABLING THE DETECTION AND TRACKING OF LOW-OBSERVABLE AIRCRAFT AND MISSILES IN CLUTTERED ENVIRONMENTS. KEY WORDS - AIRCRAFT/MISSILE DETECTION, LOW-OBSERVABLE TARGET, DETECTION/COUNTERMEASURES.

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PHYSICAL OPTICS CORP

20600 GRAMERCY PL - STE 103

TORRANCE, CA 90501

Program Manager: DE GAJENDRA SAVANT

Contract #:

Title: PV SPACE POWER GENERATION USING HOLOGRAPHIC WAVELENGTH SEPARATING CONCENTRATORS

Topic #: DARPA90-129

Office:

ID #: 42505

POC PURPOSES AN ADVANCED SOLAR POWER SYSTEM FOR SMALL SPACECRAFT THAT EMPLOYS A NEW TYPE OF HOLOGRAPHIC CONCENTRATOR TO SELECTIVELY CONCENTRATE DIFFERENT WAVELENGTHS OF SOLAR ENERGY ONTO DIFFERENT PHOTOVOLTAIC RECEIVERS. THE NOVELTY OF POC'S APPROACH INCLUDES THE USE OF ITS UNIQUE HOLOGRAPHIC TECHNOLOGY WHICH ALLOWS THE PRODUCTION OF VERY HIGHLY EFFICIENT LIGHT COLLECTORS IN THE ENTIRE VISIBLE AND NEAR IR SPECTRAL RANGE. SPECIFICALLY, POC'S IR HOLOGRAMS REPRESENT THE STATE-OF-THE-ART IN HOLOGRAPHY AND HAVE NOT BEEN MATCHED EVEN IN THE RESEARCH COMMUNITY. FURTHERMORE, THE NEW TYPE OF HOLOGRAMS ARE STABLE AT HIGH (200 DEGREE C) AND LOW (-180 DEGREE C) TEMPERATURES AS WELL AS UNDER HUMIDITY AND VACUUM CONDITIONS GENERALLY EXPERIENCED IN THE SPACE APPLICATIONS. THIS SYSTEM INVOLVING POC'S VISIBLE AND IR HOLOGRAMS ADDRESSES THE PROBLEMS OF LOW SOLAR CONVERSION EFFICIENCY AND HIGH CONCENTRATOR WEIGHT THROUGH THE USE OF DIFFERENT PHOTOVOLTAIC RECEIVER MATERIALS. BECAUSE OF THE SEPARATE PHOTOVOLTAIC CELLS, EACH WITH A DIFFERENT BAND-GAP ENERGY, RECEIVING ONLY THOSE SOLAR PHOTONS WITH ENOUGH ENERGY TO PRODUCE ELECTRON-HOLE PAIRS, THE EFFICIENCY OF CONVERSION IS HIGH. THE HOLOGRAPHIC OPTICAL ELEMENTS USED IN THIS SYSTEM ARE INHERENTLY LIGHTWEIGHT AND FLAT, MAKING DEPLOYMENT SIMPLE. OVERALL, THIS RECEIVER IS MORE EFFICIENT IN POWER, SIZE AND WEIGHT THAN EXISTING SYSTEMS. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - THE SYSTEM IS A SIGNIFICANT IMPROVEMENT OVER THE USE OF CONVENTIONAL PHOTOVOLTAIC RECEIVERS IN SPACE POWER SYSTEMS. EFFICIENCY WILL BE BETTER THAN THAT OBTAINED FROM A TENFOLD CONCENTRATION OF SOLAR RADIATION. ADDITIONALLY, CELL LIFE WILL BE EXTENDED BECAUSE PROTONS THAT ONLY CONTRIBUTE TO HEAT (AND NOT TO USEABLE ENERGY) WILL BE REJECTED BY DIFFRACTION. KEY WORDS - HOLOGRAPHIC, HOLOCONCENTRATOR, ENERGY, PHOTOVOLTAIC, SOLAR, WAVELENGTH SEPARATION

CHARLES RIVER ANALYTICS INC

55 WHEELER ST

CAMBRIDGE, MA 02138

Program Manager: DR ALPER CAGLAYAN

Contract #:

Title: AN ALTERNATIVE CONCEPT FOR AEROASSISTED ORBITAL TRANSFERS

Topic #: DARPA90-131

Office:

ID #: 42462

RECENT RESEARCH HAS INDICATED THE POTENTIAL BENEFITS OF AEROASSISTED ORBITAL TRANSFER MANEUVERS FOR REALIZING SIGNIFICANT FUEL SAVING OVER PURELY PROPULSIVE MANEUVERS FOR BOTH COPLANAR AND PLANAR TRANSFER USING APPROXIMATE CLOSED-LOOP GUIDANCE LAWS AND/OR NUMERICAL OPTIMIZATION ALGORITHMS. THIS RESEARCH HAS FOCUSED ON CURRENTLY ENVISAGED TRANSATMOSPHERIC VEHICLES. BASIC RESEARCH IS NEEDED TO INVESTIGATE OTHER POTENTIAL APPLICATIONS OF AEROASSISTED ORBITAL MANEUVERS AND TO ADDRESS THE ON-LINE IMPLEMENTATION FEASIBILITY OF SUCH ATMOSPHERIC TRAJECTORY/GUIDANCE SCHEMES. IN PARTICULAR, THERE IS A NEED TO IDENTIFY VEHICLE AND ORBITAL PARAMETERS/GEOMETRIES THAT ARE THE DESIGN DRIVERS FOR ALLOWING APPLICATION OF AEROASSISTED MANEUVERS AND FOR DETERMINING OVERALL TRANSFER PERFORMANCE OF FUEL REQUIREMENTS. AS FOR ON-LINE IMPLEMENTATION OF TRANSATMOSPHERIC GUIDANCE SCHEMES, ARTIFICIAL NEURAL NETWORKS OFFER AN ATTRACTIVE ALTERNATIVE APPROACH THAT MAY AMELIORATE THE ASSOCIATED COMPUTATIONAL BURDENS AND BE READILY ADAPTABLE TO ENVIRONMENTAL UNCERTAINTIES ENCOUNTERED DURING ATMOSPHERIC MANEUVERS. IN THIS STUDY, WE PROPOSE TO INVESTIGATE AND IDENTIFY THE POSSIBLE APPLICATION OF AEROASSISTED MANEUVERS TO OTHER VEHICLE/MISSION ELEMENTS, DETERMINE THE BASIC DESIGN DRIVERS, AND FORMULATE A

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SPECIFIC SCENARIO USING A NEURAL NETWORK APPROACH TO THE ON-LINE IMPLEMENTATION OF A GUIDANCE SCHEME. ANTICIPATED BENEFITS/POTENTIAL COMMERCIAL APPLICATIONS - WE SEE SEVERAL POTENTIAL COMMERCIAL APPLICATIONS OF OUR PROPOSED STUDY. FOR ALTERNATIVE AEROASSISTED TRANSFER CONCEPTS, WE SEE POTENTIAL BENEFIT TO COMMERCIAL AS WELL AS TO CIVILIAN GOVERNMENT AGENCIES. FOR INSTANCE, RESULTS OF THE STUDY MAY MAKE EASIER THE DEBOOST OF HEO SATELLITES TO LEO FOR EITHER SHUTTLE, OR IN THE FUTURE, SPACE STATION-BASED REPAIR/REFURBISHMENT. APPLICATIONS ARE ALSO TO THE NASP AND NASA'S OTV PROGRAM. THE NEURAL NETWORK COMMERCIAL

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SDIO Solicitation 90.1

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ADVANCED TECHNOLOGY MATERIALS INC  
520-B DANBURY RD  
NEW MILFORD, CT 06776

Program Manager: CHARLES E BEETZ JR

Contract #:

Title: CRYOGENICALLY COOLED OPTICS FOR HIGH POWER INFRARED LASERS

Topic #: SDIO90-001

Office:

ID #: 40751

WHEN A LASER BEAM IRRADIATES AN OPTICAL MATERIAL WITH INTENSE PHOTONS, THE LASER MAY DAMAGE THE OPTICAL MATERIAL. FURTHER, HEAT BUILDS UP, WHICH DISTORTS THE OPTICS IN THE LASER CAVITY. ORDINARY MATERIALS HAVE A LOW THRESHOLD BEFORE DAMAGE OCCURS, WHICH COULD COMPROMISE THE DESIGN OF LASER WINDOWS AND MIRRORS. HOWEVER, DIAMOND CAN BE EMPLOYED IN PULSED HIGH-ENERGY LASERS, AND FREE ELECTRON LASERS (FEL'S), BECAUSE DIAMOND ABSORBS VERY FEW PHOTONS, IT READILY CONDUCTS HEAT, AND IT EXPANDS VERY LITTLE WHEN HEATED. THIS PROJECT WILL DESIGN AN OPTICAL ELEMENT THAT IS CRYOGENICALLY COOLED FOR USE IN THE CAVITY OF AN FEL. THE OPTICAL ELEMENT IS A RESONANT REFLECTOR STACK THAT RESEMBLES A MULTILAYER COATING. THE ELEMENT CONSISTS OF A SERIES OF STACKED THIN DIAMOND PLATES WITH A SMALL GAP BETWEEN THE PLATES. THE GAP ALSO SERVES BY PASSING A FLOW OF COLD NITROGEN GAS OR LIQUID OVER THE FACES OF THE PLATES, WHICH COOL THE PLATES. DIAMOND RESONATOR REFLECTOR STACKS ALLOW ULTRA-HIGH POWER FEL'S TO BE MADE FOR GROUND-BASED LASER WEAPONS. THE TECHNOLOGY COULD LEAD TO LONGER WAVELENGTH FEL'S AND TO COOLED REFLECTORS FOR HIGH POWER NEAR IR AND IR LASERS. CRYOGENICALLY-COOLED DIAMOND FILM OPTICS PERMIT MORE COMPACT FEL CAVITY DESIGNS THAN POSSIBLE WITH PRESENT OPTICAL MATERIALS.

CLEVELAND CRYSTALS INC  
19306 REDWOOD AVE  
CLEVELAND, OH 44110  
Program Manager: J D BEASLEY

Contract #:

Title: CADMIUM-MANGANESE-TELLURIDE: A NEW MAGNETO-OPTIC CRYSTAL

Topic #: SDIO90-001

Office:

ID #: 40752

THE FOCUS OF THIS PROJECT IS TO GROW AND CHARACTERIZE CRYSTALS OF CADMIUM MANGANESE TELLURIDE (CMT). CMT IS A NEW MAGNETO-OPTIC MATERIAL THAT CAN, WHEN IT IS SUBJECTED TO A MAGNETIC FIELD, ROTATE THE POLARIZATION VECTOR OF LIGHT. IT CAN BE USED TO MAKE OPTICAL ISOLATORS FOR THE LONG VISIBLE AND INFRA-RED (IR) REGIONS. A LASER CAN BE PROTECTED BY AN OPTICAL ISOLATOR THAT IS DESIGNED TO TRANSMIT LIGHT EXITING FROM A LASER BUT TO STOP LIGHT DIRECTED TOWARD THE LASER. COMPARED TO OTHER COMMON MAGNETO-OPTIC MATERIALS, CMT REQUIRES A WEAKER MAGNETIC FIELD TO PRODUCE A GIVEN OPTICAL ROTARY EFFECT. FOR EXAMPLE, THE MAGNETO-OPTIC EFFECT IS 3 TO 10 TIMES STRONGER IN CMT THAN IT IS IN TERBIUM GALLIUM GARNET (TGG) FOR THE WAVELENGTH RANGE FROM 0.6 TO 1.1 MICRONS. USE IN OPTICAL ISOLATORS IS AN IMPORTANT APPLICATION FOR CMT BECAUSE IT PERMITS THE USE OF MAGNETS OF LOWER STRENGTH THAN THE ONES REQUIRED FOR ISOLATORS BASED ON OTHER MATERIALS. CMT CONTAINING VARIOUS PERCENTAGES OF MANGANESE CAN BE PRODUCED IN ORDER TO OPTIMIZE CHARACTERISTICS FOR A NUMBER OF USES. CMT CAN SERVE AS A SUBSTRATE FOR THE EPITAXIAL GROWTH OF (HG,MN)TE AND (HG,CD,MN)TE DETECTORS FOR THE IR REGION. ADDITIONALLY, CMT CAN BE USED WITH PSEUDO-PHASE MATCHING FOR SECOND HARMONIC GENERATION WITH IR INPUT WAVELENGTHS AS LONG, IN PRINCIPLE, AS 30 MICRONS.

J.B.S. TECHNOLOGIES INC  
631 KENDALE LANE



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SDIO Solicitation 90.1

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THOUSAND OAKS, CA 91360

Program Manager: DR JEFFREY B SHELLAN

Contract #:

Title: VERSATILE HIGH PERFORMANCE HOLOGRAPHIC OPTICAL COATINGS

Topic #: SDIO90-001

Office:

ID #: 40745

THIS PROJECT WILL EMPLOY HOLOGRAPHIC TECHNIQUES TO FABRICATE OPTICAL MATERIALS IN ONE STEP UP TO SEVERAL HUNDRED LAYERS THICK. THE METHOD CAN TAILOR THE REFLECTIVE PROPERTIES IN EACH LAYER. IN THIS PROCESS, TWO LASER BEAMS INTERFERE WITHIN A PHOTSENSITIVE LAYER, CREATING A STANDING WAVE PATTERN. THIS WAVE PATTERN CONTROLS HOW THE COATING WILL REFLECT LIGHT AT A PARTICULAR WAVELENGTH. BY MAKING MULTIPLE EXPOSURES AT DIFFERENT WAVELENGTHS, ONE CREATES A STRUCTURE THAT REFLECTS VERY STRONGLY AT EACH RECORDING WAVELENGTH. THE TECHNIQUE CAN FABRICATE LASER GOGGLES AND PROTECTIVE FILTERS FOR FOCAL PLANE ARRAYS. THE HOLOGRAPHIC COATING TECHNIQUE ALLOWS ONE TO MAKE COMPLEX NON-PERIODIC STRUCTURES. UNLIKE CONVENTIONAL COATINGS, HOLOGRAPHIC COATINGS CAN BE DEPOSITED AT LOW TEMPERATURES. FURTHER, THEY CAN BE APPLIED TO VERY LARGE OR HIGHLY CURVED OPTICAL SURFACES. THE COATINGS ALSO PROTECT THE OPTICS BETTER FROM INTENSE RADIATION THAT MIGHT OTHERWISE DAMAGE OR DESTROY THE SENSOR. THE TECHNIQUE PERMITS ONE TO INTEGRATE COATINGS AND GRATINGS IN ONE STRUCTURE. IN ADDITION, THE TECHNIQUE CAN BE APPLIED TO PARTS THAT REQUIRE UNUSUAL SPECTRAL REFLECTIVITY PROFILES.

MISSION RESEARCH CORP

1720 RANDOLPH RD SE

ALBUQUERQUE, NM 87106

Program Manager: SCOTT A VON LAVEN

Contract #:

Title: CROSSED-FIELD WIGGLER

Topic #: SDIO90-001

Office:

ID #: 40746

THIS PROJECT WILL DESIGN A NEW WIGGLER GEOMETRY FOR A FREE-ELECTRON LASER (FEL). THE NEW WIGGLER WILL ACCEPT A WIDER ENERGY SPREAD OF ELECTRONS, IE. A WIDER SPREAD OF ELECTRON VELOCITIES, THAN PREVIOUS WIGGLERS. HENCE, THIS WIGGLER PRODUCES THE SAME GAIN WITH A LOWER QUALITY BEAM, THEREBY SAVING MONEY ON ACCELERATORS NEEDED TO OBTAIN HIGH QUALITY BEAMS. WHEN ELECTRONS GO THROUGH A WIGGLER, THEY GIVE OFF PHOTONS OF LIGHT. THE LASER USES MIRRORS TO BOUNCE THIS LIGHT BACK AND FORTH, AND AMPLIFY IT. A NORMAL WIGGLER JUST USES A MAGNETIC FIELD -- WITH NO ELECTRIC FIELD. THIS WIGGLER INTRODUCES AN ELECTRIC FIELD PERPENDICULAR TO THE MAGNETIC FIELD. THE ELECTRIC FIELD ADDS MORE FLEXIBILITY TO THE WIGGLER DESIGN. THE ADDED ELECTRIC FIELD ALLOWS ONE TO IMPROVE THE COHERENCE OF LIGHT, ENABLING ONE TO FINE TUNE THE FREQUENCY BETTER. IT INCREASES EFFICIENCY; HENCE, IT MAY BE POSSIBLE TO GENERATE HIGHER POWER. THE CROSSED-FIELD WIGGLER FEL CAN SERVE IN TARGETING, COMMUNICATIONS, OPTICAL COMPUTING, X-RAY LITHOGRAPHY, BALLISTIC MISSILE DEFENSE, AND SPECTROSCOPY. IN MEDICINE, THE FEL CAN HELP PURIFY BLOOD TO FIGHT AIDS, TREAT CANCER, REMEDY LESIONS AND GLAUCOMA, BREAK UP KIDNEY STONES, CLEAR BLOOD CLOTS, GRAFT SKIN, AND DISINTEGRATE PLAQUE THAT CAUSES ARTERIOSCLEROSIS.

OPTICAL INSTRUMENTS CORP

71 BLAKE ST

NEEDHAM, MA 02192

Program Manager: KENNETH ROBINSON

Contract #:

Title: PERFORMANCE ANALYSIS AND PRELIMINARY DESIGN OF A PRECISION TRACKER

Topic #: SDIO90-001

Office:

ID #: 40770

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CURRENT TRACKING TECHNIQUES USE COMPUTERS TO PROCESS THE OUTPUT OF A TARGET IMAGE. ALTHOUGH ACCURACY CAN REACH 1/32 OF A PIXEL, THE RESPONSE TIME IS LIMITED BY THE FRAME RATE, AND IT REQUIRES A DEDICATED COMPUTER. THIS PROJECT WILL DEVELOP A TRACKING TECHNIQUE THAT CAN OPERATE WITHOUT A DEDICATED COMPUTER, AND ITS FREQUENCY RESPONSE IS NOT LIMITED BY THE FRAME RATE. THE TRACKER DESIGN IS ELECTRO-OPTICAL, WHICH CONTAINS VERY FEW OR NO MOVING PARTS. THIS SHOULD IMPROVE TRACKING ACCURACY AND FREQUENCY RESPONSE OVER PRESENT IMAGE TRACKING TECHNIQUES. THIS PRECISION TRACKER USES THE MOIRE PATTERN OF THE PROJECTION OF ONE GRATING UPON ANOTHER GRATING, WHICH HAS THE BEAM LINED UP WITH THE LIGHT EMANATING FROM THE TARGET IMAGE. A MOIRE PATTERN IS PRODUCED WHEN TWO SIMILAR PATTERNS OF LINES ARE SUPERIMPOSED. THE PRECISION TRACKER CAN REDUCE THE REQUIREMENTS ON THE TRACKING LENS APERTURE AND FOCAL LENGTH. IT ALSO ALLOWS THE USE OF A SMALLER DEDICATED COMPUTER. IT CAN BE APPLIED TO DISCRIMINATE BETWEEN TARGETS AND DECOYS, AS WELL AS SEPARATE MULTIPLE TARGETS. THE TRACKER COULD SERVE IN INSTRUMENTATION THAT COULD PRECISELY MEASURE THE VELOCITY OF AIRCRAFT AT TAKE-OFF OR DURING FLIGHT.

PHYSICAL SCIENCES INC  
20 NEW ENGLAND BUSINESS CTR  
ANDOVER, MA 01810  
Program Manager: DR STEVEN J DAVIS  
Contract #:  
Title: VIBRATIONALLY ASSISTED ENERGY TRANSFER LASER CONCEPT  
Topic #: SDIO90-001                      Office:                      ID #: 40749

PHASE I WILL TEST A NOVEL ENERGY TRANSFER CONCEPT, WHICH COULD BE DEVELOPED INTO A SHORT-WAVELENGTH CHEMICAL LASER (SWCL). THIS CONCEPT UTILIZES CHEMICALLY PRODUCED, NON-THERMAL VIBRATIONAL ENERGY WITHIN THE GROUND ELECTRONIC STATE OF POTENTIAL LASER CANDIDATES. THE NON-THERMAL ENERGY CAN ENHANCE ENERGY TRANSFER FROM METASTABLE SPECIES SUCH AS NF(A) OR O2(A) TO PREVIOUSLY DEMONSTRATED LASERS SUCH AS IF(B). THIS ASSISTED ENERGY TRANSFER PROCESS HAS THE POTENTIAL FOR PRODUCING AN EFFICIENT AND TUNABLE SWCL. TUNABLE SWCLS COULD FIND APPLICATIONS IN MEDICINE FOR PHOTODYNAMIC CANCER THERAPY, IN THE SEMICONDUCTOR INDUSTRY AS PHOTOETCHERS, AND AS A RESEARCH TOOL IN UNIVERSITY AND GOVERNMENT LABORATORIES.

PHYSICS & ENGINEERING RESEARCH  
1120 N PATTERSON AVE  
SANTA BARBARA, CA 93111  
Program Manager: AVNER AMIR  
Contract #:  
Title: INFRARED TO FAR-INFRARED COHERENT RADIATION SOURCE  
Topic #: SDIO90-001                      Office:                      ID #: 40744

THIS PROJECT WILL DEVELOP AN ELECTRON BEAM DEVICE, WHICH OPERATES IN THE INFRARED TO FAR-INFRARED RANGE. THE DEVICE USES STIMULATED DIFFRACTION RADIATION FROM A WIRE GRATING. AN ELECTRON BEAM PASSES THROUGH A METAL GRATING MADE OF THIN PARALLEL WIRES, WHICH EXTEND PERPENDICULAR TO THE DIRECTION OF MOTION. IF THE BEAM IS CLOSE ENOUGH TO THE WIRES, A DIFFRACTED WAVE IS GENERATED AT A BROAD RANGE OF FREQUENCIES. RADIATION AT THE DESIRED FREQUENCY IS STORED INSIDE A RESONATOR CAVITY. THE REPEATED ACTION OF THE WAVE OF ELECTRONS CAUSES BUNCHING, WHICH AMPLIFIES THE FIELD, AND ESTABLISHES LONG RANGE COHERENCE SIMILAR TO A FREE-ELECTRON LASER. THE DEVICE CAN BE TUNED OVER A WIDE RANGE: 10 TO 500 MICRONS. IT CAN REACH HIGH POWER: 1.5 KW IN CONTINUOUS WAVE, AND 10 KW IN PULSED. THE DEVICE IS COMPACT, WITH AN INTERACTION SECTION ONLY 15 CM LONG. IT'S ALSO LOW IN COST--ONLY 1/10 THE COST OF A COMPARABLE COUPLING AT SHORTER WAVELENGTHS COMPARED TO OTHER GRATING DEVICES. RECIRCULATING THE ELECTRON BEAM INCREASES EFFICIENCY--UP TO 75%. THE DEVICE CAN

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BE APPLIED IN LASER RADAR, COMMUNICATIONS, MEDICINE, MATERIAL PROCESSING, PHOTO-INDUCED CHEMICAL REACTIONS, AND SPECTROSCOPY.

SCIENCE RESEARCH LAB INC  
15 WARD ST  
SOMERVILLE, MA 02143  
Program Manager: DR JONAH JACOB

Contract #:

Title: SCALING CW ELECTRON BEAM PUMPED RATE GAS LASERS TO ULTRA-HIGH AVERAGE POWER

Topic #: SDIO90-001

Office:

ID #: 40795

THIS PROJECT WILL SHOW THAT RARE (NOBLE) GAS LASERS, SPECIFICALLY AR:XE, CAN BE EFFICIENTLY SCALED UP TO AVERAGE POWERS OF UP TO 100 MW PER APERTURE. 100 MW REPRESENTS A VERY POWERFUL CONTINUOUS WAVE LASER—MORE POWERFUL THAN HAS EVER BEEN BUILT BEFORE. THE AR:XE LASER, WHICH OPERATES AT A NEAR INFRARED (IR) WAVELENGTH OF 1.73 MICRONS, RECENTLY LASED AT OVERALL ELECTRICAL EFFICIENCIES OF 4 TO 6%, WHEN IT WAS PUMPED BY ELECTRON BEAMS OR FISSION FRAGMENTS AT SCIENCE RESEARCH LABORATORY AND SANDIA NATION LABORATORY. AN EFFICIENCY OF 4-5% SURPASSES THE 2-3% EFFICIENCY OF VISIBLE LIGHT LASERS. THIS NEW AR:XE LASER CAN BE SCALED UP TO AND NEAR DIFFRACTION LIMITED BEAM QUALITY. THE PROPOSED CONCEPT LEADS TO AN INEXPENSIVE, COMPACT, SHORT-WAVELENGTH LASER THAT PERFORMS BETTER AND COSTS ONLY 1/3 THAT OF FREE ELECTRON LASERS (FEL), AND LESS THAN CO2 AND EXIMER CONCEPTS. THE RARE GAS LASER'S WAVELENGTH MEASURES 5-6 TIMES SHORTER THAN CO2, ALLOWING ONE TO FOCUS IT BETTER, BECAUSE MORE ENERGY WILL GO INTO A SMALLER SPOT. FURTHER, RARE GAS LASERS CONTAIN SEVERAL TRANSITIONS, RANGING FROM 0.63 MICRONS IN THE VISIBLE RANGE TO 4 MICRONS IN THE IR. THE LOWER POWER TRANSITIONS CAN SERVE IN SENSORS AND TOMOGRAPHY. MEANWHILE, HIGHER POWER TRANSITIONS CAN BE APPLIED IN LASER SURGERY, CUTTING METAL, WELDING, AND WORK HARDENING.

XEMET INC  
18804 NORTH CREEK PKWY - #110  
BOTHELL, WA 98011  
Program Manager: RICHARD B MINCH

Contract #:

Title: HIGH FLOW LOW DIMER BISMUTH VAPOR SOURCE

Topic #: SDIO90-001

Office:

ID #: 40742

THIS PROJECT WILL PROVIDE A BISMUTH VAPOR SOURCE FOR A CHEMICAL LASER, WHICH OPERATES IN THE BLUE-GREEN SPECTRUM, WHERE ATMOSPHERIC ABSORPTION IS LOW. MONATOMIC BISMUTH VAPOR WILL BE USED TO CREATE AN EFFICIENT 25 KW BIF CONTINUOUS WAVE (CW) LASER. THE TECHNOLOGY CAN SUPPORT LARGE SCALE CW LASERS—UP TO 500 KW. THE BISMUTH VAPOR CAN PRODUCE 0.01 MOLES/SQUARE-CM/SECOND, WHICH IS 50 TO 100 TIMES GREATER THAN PREVIOUS METHODS. THE METHOD ALSO DOES NOT FORM DROPLETS, WHICH CAN BE A PROBLEM. THE DESIGN CONTAINS AN INTERNAL HEAT EXCHANGER, WHICH SUPERHEATS THE BISMUTH VAPOR TO REDUCE THE CONCENTRATION OF DIMER MOLECULES. A DIMER CONSISTS OF TWO IDENTICAL SIMPLER MOLECULES. BISMUTH DIMERS NEED TO BE ELIMINATED BECAUSE THEY TEND TO QUENCH THE PUMPING MECHANISM OF THE LARGER. MOST CHEMICAL LASERS ARE LIMITED IN THEIR ABILITY TO MIX GAIN AND PHASE. THIS NEW METHOD OFFERS VERY FAST MIXING, AND CAN FORM VERY HOMOGENEOUS REACTANTS TO OVERCOME GAIN AND PHASE LIMITATIONS. THE TECHNOLOGY CAN BE EXTENDED TO CHEMICAL LASER NOZZLES, TO VAPORIZING METALS, AND TO DILUENT SYSTEMS.

BARRON ASSOCS INC  
RTE 1 - BOX 159

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SDIO Solicitation 90.1

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STANARDSVILLE, VA 22973

Program Manager: ROGER L BARRON

Contract #:

Title: OPTIMAL ENERGY MANAGEMENT FOR KINETIC ENERGY WEAPONS

Topic #: SDIO90-002

Office:

ID #: 40790

BARRON ASSOCIATES WILL DESIGN A GUIDANCE SEEKER FILTER WITH VARIABLE PARAMETERS. THE VALUES OF THE PARAMETERS WILL BE COMPUTED BY A NEURAL NETWORK, WHICH WILL OPTIMIZE THE MANAGEMENT OF FUEL FOR THE KINETIC ENERGY WEAPON (KEW). TYPICALLY, A KEW IS BUDGETED A CERTAIN AMOUNT OF FUEL FOR MID-COURSE AND TERMINAL GUIDANCE. THE AMOUNT OF FUEL BUDGETED DEPENDS ON SIMULATED RESULTS AND TENDS TO BE CONSERVATIVE--WITH EXCESS FUEL LEFT OVER AT INTERCEPT. THE NEW GUIDANCE FILTER SYSTEM CAN HELP SPEND THIS "EXTRA" FUEL DURING TERMINAL GUIDANCE TO INCREASE ACCURACY. THE NEW SYSTEM ADAPTIVELY CONTROLS THE GUIDANCE FILTER TIME CONSTANTS. THIS CONTROL PERMITS THE GUIDANCE FILTER TO RESPOND FASTER, REDUCING THE MISS DISTANCE, THEREBY INCREASING ACCURACY. PROPER CONTROL OF THE FILTER TIME CONSTANTS CAN ALSO MINIMIZE SENSOR NOISE. SENSOR NOISE MAKES IT DIFFICULT TO FIND THE TARGET, CAUSING THE KEW TO WASTE MOTION AND WASTE FUEL. THE SYSTEM CAN ALSO SAVE FUEL IN OTHER FORMS OF TRANSPORTATION: CARS, BOATS, SUBMARINES, AIRPLANES, AND SPACECRAFT.

GELTECH INC

PO BOX 18 - ONE PROGRESS BLVD

ALACHUA, FL 32615

Program Manager: JEAN-LUC R NOGUES

Contract #:

Title: TRANSPIRATION COOLED ULTRAVIOLET SOL-GEL SILICA OPTICS

Topic #: SDIO90-002

Office:

ID #: 40811

TODAY, THE BEST MATERIAL FOR WINDOWS IN ROCKET GUIDANCE SYSTEMS IS SAPPHIRE. HOWEVER, SAPPHIRE IS VERY DIFFICULT TO MANUFACTURE AND VERY EXPENSIVE. USING A SOL-GEL PROCESS, GELTECH CAN CREATE A HIGHLY PURE, POROUS SILICA, CALLED TYPE VI SILICA, WHICH CAN REPLACE SAPPHIRE IN ROCKET WINDOWS. THE SOL-GEL PROCESS PRODUCES PURE SILICA BY CHEMICALLY REACTING SILICON ALKOXIDE WITH WATER. MIXING WITH WATER HYDROLIZED THE ALKOXIDE TO PRODUCE A SUSPENSION OF COLLOIDAL SILICA-BASED PARTICLES, CALLED A "SOL". AFTER HOMGENIZING, THE SOL IS CAST INTO A MOLD WHERE IT SETS INTO A POROUS WET GEL HAVING THE SHAPE OF THE MOLD. THE GEL IS THEN DRIED TO GIVE TRANSPARENT SILICA. THIS TYPE VI SILICA CONTAINS GOOD STRUCTURAL STRENGTH, CAN TRANSMIT UV OVER A BROAD RANGE, AND CAN WITHSTAND HIGH TEMPERATURES. THE DRY GEL CAN BE FURTHER HEAT TREATED TO GIVE IT GREATER STRENGTH, OPTICAL TRANSMISSION, AND THERMAL STABILITY. THE ULTRA-POROUS STRUCTURE OF TYPE VI SILICA ALLOWS GASES TO PASS THROUGH IT, PROVIDING SIGNIFICANT COOLING. THIS COOLING IMPROVED THE PERFORMANCE OF ROCKET WINDOWS. TYPE VI SILICA ALSO COSTS MUCH LESS THAN SAPPHIRE. SOL-GEL PROCESSING CAN PRODUCE POROUS SILICA FOR OPTICAL FIBERS AND COMPONENTS FOR OPTICAL COMPUTERS.

IAP RESEARCH INC

2763 CULVER AVE

DAYTON, OH 45429

Program Manager: DAVID P BAUER

Contract #:

Title: HIGH-EFFICIENCY ELECTROMAGNETIC LAUNCHER

Topic #: SDIO90-002

Office:

ID #: 40727

IN LAUNCHING A PROJECTILE, AN ELECTROMAGNETIC RAILGUN WASTES SIXTY PERCENT OF THE ENERGY. THIS PROJECT WILL NEARLY ELIMINATE THE ENERGY LOST TO THE MAGNETIC FIELD BETWEEN THE

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RAILS--35% OF THE TOTAL ENERGY. IN CONVENTIONAL RAILGUNS, THE MAGNETIC FIELD BETWEEN THE RAILS ACCELERATES THE ARMATURE, WHICH IN TURN ACCELERATES THE PROJECTILE. THE NEW RAILGUN OPERATES SIMILAR TO A CONVENTIONAL RAILGUN. CURRENT FLOWS DOWN ONE RAIL, INTO THE TRAILING ARM OF THE ARMATURE, THROUGH THE ARMATURE, THROUGH THE OTHER TRAILING ARM, AND FINALLY BACK THROUGH THE SECOND RAIL. UNLIKE A CONVENTIONAL GUN, THIS DESIGN BRINGS THE TWO RAILS VERY CLOSE TOGETHER, WHICH REDUCES THE FIELD BETWEEN THE RAILS, THEREBY ELIMINATING ENERGY LOST AND INCREASES EFFICIENCY. THE MAGNETIC FIELD REQUIRED TO ACCELERATE THE ARMATURE IS NOT GENERATED BY THE RAILS, BUT BY THE TRAILING ARMS OF THE ARMATURE. THIS NEW METHOD ALSO MINIMIZES MUZZLE FLASH, WHICH CAN KNOCK A PROJECTILE OUT OF ITS LINE OF FLIGHT. UNLIKE CONVENTIONAL RAILGUNS, THIS DESIGN WIDENS THE RAILS, WHICH INCREASES THE MAGNETIC FIELD ON THE ARMATURE, THEREBY INCREASING THE ACCELERATING FORCE ON THE PROJECTILE--WITHOUT A LOSS OF EFFICIENCY. RAILGUNS CAN SERVE IN ANTI-TANK, ANTI-AIRCRAFT, AND OTHER HYPERVELOCITY WEAPONS. THEY WILL WORK ON BOTH MOBILE AND STATIONARY PLATFORMS. THEY CAN ALSO LAUNCH MISSILES, SMALL SATELLITES, AND PARTS FOR THE SPACE STATION.

IAP RESEARCH INC

2763 CULVER AVE

DAYTON, OH 45429

Program Manager: JOHN P BARBER

Contract #:

Title: NESTED-CHEVRON GUN FOR ULTRA-HIGH LAUNCH VEHICLES

Topic #: SDIO90-002

Office:

ID #: 40794

MANY ELECTROMAGNETIC (EM) LAUNCH APPLICATIONS REQUIRE VELOCITIES UP TO 10 KM/SEC., HOWEVER, CURRENT EM RAILGUNS WITH PLASMA ARMATURES REACH A LIMITING VELOCITY OF 6 KM/SEC. IN AN EM RAILGUN, A CURRENT FLOWS THROUGH THE ARMATURE AND CREATES A MAGNETIC FIELD THAT PROPELS THE PROJECTILE. AS VELOCITY INCREASES, THE ELECTROMOTIVE FORCE (EMF) BEHIND THE PROJECTILE INCREASES. THIS EMF CREATES A VOLTAGE ACROSS THE RAILS. AT THE SAME TIME, THE "SPENT" PLASMA ESCAPING FROM THE BACK OF THE ARMATURE PRODUCES HIGHER TEMPERATURES AND PRESSURES, WHICH LOWER THE BREAKDOWN STRENGTH OF THE RAIL GAP BEHIND THE ARMATURE. WHEN THE INCREASING EMF EXCEEDS THE DECREASING BREAKDOWN STRENGTH OF THE RAIL GAP, DIELECTRIC BREAKDOWN OCCURS, CAUSING A SECONDARY CURRENT TO FORM IN THE RESIDUAL PLASMA BEHIND THE ARMATURE. ONCE FORMED, THIS SECONDARY CURRENT GROWS BY SHUNTING, OR PULLING AWAY, CURRENT FROM THE MAIN ARMATURE. THIS REDUCTION OF THE MAIN CURRENT CAUSES THE OBSERVED DROP IN PROJECTILE ACCELERATION. THIS PROJECT WILL PREVENT SECONDARY CURRENTS BY REMOVING THE VOLTAGE ACROSS THE RAILS. THE CONCEPT EMPLOYS CHEVRONS, OR V-SHAPES, WHICH ARE NESTED INTO THE RAILS. EACH CHEVRON CONDUCTOR IS ELECTRICALLY INSULATED FROM ITS NEIGHBORS, AND EACH CHEVRON PAIR (ONE ON EACH RAIL) IS CONNECTED TO A SEPARATE ENERGY STORE. AS THE PROJECTILE MOVES DOWN THE RAILGUN, IT DOES NOT AFFECT THE CHEVRONS IN FRONT OF THE PROJECTILE. WHEN THE ARMATURE COMES IN CONTACT WITH THE NTH CHEVRON, CURRENT BEGINS TO FLOW. THE CURRENT FLOWS FROM THE NTH ENERGY STORE, THROUGH ONE CHEVRON, THROUGH THE ARMATURE TO THE MATCHING CHEVRON ON THE OPPOSITE RAIL, AND THEN BACK TO THE ENERGY STORE. THE RAILS BEHIND THE PROJECTILE ARE AUTOMATICALLY ELECTRICALLY DISCONNECTED WHEN THE ARMATURE MOVES OFF THE CHEVRON TIP. THIS REMOVES THE VOLTAGE FROM ACROSS THE RAILS AND ELIMINATES A SECONDARY ARC FROM FORMING, THEREBY PERMITTING GREATER VELOCITIES. THE METHOD ALSO GREATLY INCREASES EFFICIENCY--UP TO A THEORETICAL LIMIT OF 90%, COMPARED TO CURRENT RAILGUN EFFICIENCIES OF ONLY 20%. APPLICATIONS OF THIS METHOD INCLUDE LETHALITY TESTING, STRATEGIC AND TACTICAL DEFENSE, BALLISTIC MISSILES, PHYSICS RESEARCH, AND IMPACT FUSION.

PHYSICAL RESEARCH INC

25500 HAWTHORNE BLVD - STE 2300

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SDIO Solicitation 90.1

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TORRANCE, CA 90505

Program Manager: JAMES E CRAIG

Contract #:

Title: NONINTRUSIVE OPTICAL PROBE MEASUREMENT OF TURBULENT DENSITY FLUCTUATIONS IN  
HYPERSONIC AERO-OPTICS TESTS

Topic #: SDIO90-002

Office:

ID #: 40810

A LASER-BASED OPTICAL PROBE BOTH SENSES AND MEASURES THE FLUCTUATION IN DENSITY AND INDEX OF REFRACTION IN TURBULENT FLOWS. THE PROBE WILL BE TESTED IN HYPERSONIC WIND TUNNELS. UNLIKE OTHER METHODS, THE PROBE DIRECTLY SENSES CHANGES IN THE INDEX OF REFRACTION, WHICH ENABLES IT TO ANALYZE MULTIPLE GAS MIXTURES AND CHEMICALLY REACTING FLOWS. OTHER METHODS MEASURE DENSITY, AND CANNOT ACCURATELY DETERMINE THE INDEX OF REFRACTION FOR MIXTURES OF GASES. THE NEW METHOD IS NON-INTRUSIVE, EMPLOYING AN OPTICAL PROBE RATHER THAN A PHYSICAL PROBE, SO IT CAN SURVIVE IN HIGHER TEMPERATURES, SUCH AS THOSE ENCOUNTERED IN HYPERSONIC FLOW. THE CONFIGURATION OF THE PROBE ALLOWS IT TO MEASURE SINGLE POINTS OR MULTIPLE-POINTS SIMULTANEOUSLY. THE PROBE'S HIGH FREQUENCY RESPONSE (1 MHZ) ALLOWS IT TO MEASURE HIGH SPEED TURBULENT FLOW IN SHORT DURATIONS, SUCH AS SHOCK WAVES. THE OPTICAL PROBE CAN PROVIDE THE TURBULENCE MEASUREMENTS NEEDED BY ENDO-ATMOSPHERIC INTERCEPTORS. THE TURBULENCE DATA HELPS DEFINE CRITICAL SENSOR IMAGES. IN APPLICATIONS, THE PROBE CAN MEASURE TURBULENT FLOW IN HIGH-SPEED PROPULSION SYSTEMS, OR HYPERSONIC COMBUSTION CHAMBERS, SUCH AS RAMJETS OR SCRAMJETS.

REFRACTORY COMPOSITES, INC.

12220-A RIVERA ROAD

WHITTIER, CA 90606

Program Manager: MR. PAQUETTE

Contract #:

Title: ADVANCED FLUIDIC HOT GAS VALVE

Topic #: SDIO90-002

Office:

ID #: 20000

THIS PROJECT WILL MAKE A HOT GAS VALVE BY FILAMENT WINDING CARBON/CARBON COMPOSITES. THE COMPOSITE VALVE IS THEN COATED WITH A THIN LAYER OF RHENIUM, A REFRACTORY METAL. THE DESIGN ALSO INTEGRATES THE PILOT FLOW FUNCTION AND THE AMPLIFIER STAGES. THE VALVE CAN WITHSTAND INTERNAL PRESSURES UP TO 2000 PSI, AND TEMPERATURES, IN EXCESS OF 35000 F. YET THE TOTAL SYSTEM, INCLUDING THE THRUSTER BODY, NOZZLES, AND SPARK PLUGS WEIGHS ONLY 230 GRAMS (ONE HALF POUND). THIS IS LESS THAN 1/2 THE WEIGHT OF CURRENT LAMINATED RHENIUM VALVES, AND 8 TIMES LESS THAN SOLID METAL GAS VALVES WITH SEPARATE PILOT VALVE STAGES. THIS DIVERT PROPULSION DESIGN CAN FIND USE IN BOTH INTERCEPT AND SELF-PROTECT MISSIONS, INCLUDING AIR VEHICLES, AIR BASES, SHIPS, AND THEATRE MISSILE DEFENSE. INTERCEPT MISSIONS EXTEND FROM ENDO TO EXOATMOSPHERIC ZONES. THIS DIVERT PROPULSION TECHNOLOGY MAY EVEN BENEFIT SOME TERMINAL MANEUVERING PRECISION-GUIDED MUNITIONS. THESE HOT GAS VALVES MAY ALSO AID IN DEVELOPING HOT HYDROGEN FLOW CONTROL VALVES FOR HYPERSONIC VEHICLES.

ANDROMEDA CORP

8302 WHITESBURG DR - STE B

HUNTSVILLE, AL 35802

Program Manager: ROBERT E HOWLE

Contract #:

Title: INFRARED SENSOR CALIBRATION DEVICE

Topic #: SDIO90-003

Office:

ID #: 40786

THIS PROJECT WILL INVESTIGATE TECHNICAL FEASIBILITY AND PERFORM A PRELIMINARY DESIGN OF AN OPTO-MECHANICAL DEVICE THAT, WITH A LASER OPTICAL SOURCE, PRECISELY AND RAPIDLY CALIBRATES

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AN INFRARED (IR) FOCAL PLANE ARRAY. THE TECHNIQUE CAN CALIBRATE IR SENSORS IN THE LABORATORY OR IN SITU. IN CALIBRATION TESTS, THE OPTICAL SIGNAL FROM A BROAD SPECTRAL BAND BLACKBODY SOURCE WOULD BE COMPARED TO AN "EQUIVALENT" MONOCHROMATIC (LASER) SOURCE. IN OPERATION, A BLACKBODY SOURCE WOULD NOT BE UTILIZED. THE LASER OPTICAL SIGNAL IS PRECISELY CONTROLLED BY A FRUSTRATED TOTAL INTERNAL REFLECTION (FTIR) OPTICAL ATTENUATOR. THE DEVICE CAN SIMULATE THE OPTICAL SIGNAL INPUT TO A STARING OR SCANNING SENSOR. USING THIS TECHNIQUE IN CALIBRATION AS A VARIABLE ATTENUATOR, IT CAN ACCURATELY AND PRECISELY CONTROL THE POWER OF A LASER BEAM. THIS TECHNIQUE CAN MEASURE SENSOR RESPONSE AND CALIBRATE A SENSOR BY PROVIDING A KNOWN NUMBER OF PHOTONS OF A KNOWN ENERGY TO AN IR SENSOR IN A GIVEN PERIOD OF TIME. CURRENT TECHNIQUES REQUIRE MANY HOURS TO CALIBRATE AN IR SENSOR ARRAY, WHILE THIS TECHNIQUE COULD POTENTIALLY PERFORM THIS TASK IN 1 TO 5 MINUTES. BECAUSE THIS DEVICE IS SMALL, LIGHTWEIGHT, AND RELATIVELY SIMPLE, IT CAN BE MADE AN INTEGRAL PART OF THE BASIC SENSOR PACKAGE, RATHER THAN A SEPARATE CALIBRATION TOOL. AFTER A NUMBER OF YEARS, THE SENSOR RESPONSE CHANGES AND THE SENSOR MUST BE RECALIBRATED. IF INTEGRATED INTO THE SENSOR SYSTEM, IT COULD RECALIBRATE THE SENSOR JUST PRIOR TO LAUNCH OF AN OPTICAL PROBE 1 TO 2 YEARS LATER.

APA OPTICS INC  
2950 NE 84TH LN  
BLAINE, MN 55434

Program Manager: DR M ASIF KHAN

Contract #:

Title: ALUMINUM-GALLIUM-NITRIDE BASED INTEGRATED FILTER THREAT WARNING DETECTOR ASSEMBLY AND SOLAR BLIND UV DETECTION

Topic #: SDIO90-003

Office:

ID #: 40759

HIGH QUALITY SINGLE CRYSTAL LAYERS OF  $AL(X)GA(1-X)N$  WILL BE DEPOSITED OVER SAPPHIRE SUBSTRATES USING A SWITCHED METAL-OXYGENCHEMICAL VAPOR DEPOSITION PROCESS.  $AL(X)GA(1-X)N$  IS A COMPOUND SEMICONDUCTOR SYSTEM WITH A BANDGAP TUNABLE FROM 220NM TO 360 NM, MAKING IT SUITABLE FOR ULTRAVIOLET DEVICES. DUE TO THE DIRECT BANDGAP, INTRINSIC SENSORS BASED ON THIS MATERIAL SHOW A SHARP CUTOFF AT WAVELENGTHS CORRESPONDING TO THE BANDGAP. SIMILARLY, THE REFRACTIVE INDEX OF  $AL(X)GA(1-X)N$  IS ALSO TUNABLE FROM 2.2 (ALN) TO 2.6 (GAN), SO IT CAN SERVE IN AN INTERFERENCE TYPE QUARTER WAVE FILTER. PHASE I WILL CREATE A  $AL(X)GA(1-X)N$  INTEGRATED FILTER-DETECTOR ASSEMBLY, WHICH WILL BE DEPOSITED ON OPPOSITE SIDES OF A BASAL PLANE SAPPHIRE SUBSTRATE. THE AIM IS TO DEPOSIT EPITAXIAL LAYERS ON THE BACK SIDE OF THE SUBSTRATE WITHOUT HURTING THE FILTER. THE DEVICE CAN SERVE AS A HIGH REJECTION, I.E. VERY SELECTIVE, HIGH RESPONSIVITY SOLAR BLIND UV DETECTOR. APPLICATIONS ARE IN THREAT WARNING SYSTEMS, COMMERCIAL FLAME SAFEGUARD SYSTEMS, AND EXCIMER LASER MIRRORS FOR HIGH POWER OPERATION.

APA OPTICS INC  
2950 NE 84TH LN  
BLAINE, MN 55434

Program Manager: DR M ASIF KHAN

Contract #:

Title: ALUMINUM-GALLIUM-NITROGEN BASED SOLID STATE PHOTOMULTIPLIER FOR SOLAR BLIND UV DETECTION

Topic #: SDIO90-003

Office:

ID #: 40761

THIS PROJECT WILL DEVELOP A ALGAN SOLD-STATE PHOTODETECTOR. THE DETECTOR SENSES ONLY UV RADIATION; IT IS SOLAR BLIND (DOES NOT REPSOND TO VISIBLE LIGHT). BECAUSE THE DETECTOR IS SOLAR BLIND, IT CAN GET A CLEARER UV SIGNAL WITH LESS BACKGROUND NOISE FROM VISIBLE LIGHT, MAKING IT SUITABLE FOR EARLY WARNING SYSTEMS. UNLIKE IR, UV SENSORS CAN EASILY DISTINGUISH BETWEEN

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THE HOT PLUME AND THE ROCKET ITSELF. FURTHER, UV SENSORS ARE SMALLER AND DON'T REQUIRE COOLING. IN A NUCLEAR WAR, UV MAY BE MORE EFFECTIVE THAN IR, WHICH MIGHT BE OVERLOADED BY SHORT BLASTS FROM NUCLEAR FIRES. UV SENSORS ALSO COST ABOUT 1/10 THAT OF IR SENSORS. THIS PROJECT WILL USE ALGAN BECAUSE ITS ONE OF THE ONLY MATERIALS THAT CAN BE PROVIDE A SHARP, LONG-WAVELENGTH CUTOFF. THE UV SENSORS CONSIST OF A HIGH-GAIN SCHOTTKY BARRIER DETECTOR INTEGRATED WITH A SOLID-STATE PHOTOMULTIPLIER. A SCHOTTKY BARRIER IS THE BARRIER BETWEEN A SEMICONDUCTOR AND A METAL, SUCH THAT APPLYING AN ELECTRIC FIELD INCREASES THE THERMIONIC EMISSION FROM THE METAL TO THE SEMICONDUCTOR. SOLAR BLING UV SENSORS CAN SERVE IN THREAT WARNING SYSTEMS, LASER MIRRORS, AND FLAME SAFEGUARD DETECTORS IN HOMES, OIL AND GAS PLANTS, BOILERS, AND OIL HEATERS.

CANDELA LASER CORP  
530 BOSTON POST RD  
WAYLAND, MA 01778  
Program Manager: E B TREACY  
Contract #:  
Title: NEGATIVE LENS LASER  
Topic #: SDIO90-003

Office: ID #: 40764

THIS PROJECT WILL DEVELOP A SIMPLE AND COMPACT SOLID STATE LASER. THE LASER IS FABRICATED WITH A THIN NEGATIVE LENS. THE LASER SHOULD SHOW VIRTUALLY NO DIFFRACTIVE EFFECTS INSIDE THE LASER MATERIAL. UNLIKE STANDARD LASER RESONATORS, WHICH ARE UNSTABLE, THE DISTRIBUTION OF LIGHT INSIDE THE NEGATIVE LENS LASER WILL NOT DEVIATE MUCH FROM THAT PREDICTED BY GEOMETRIC OPTICS. THIS SIMPLE COMPACT LASER CAN BE EASILY MAINTAINED AND PRODUCES GOOD BEAM QUALITY. THE SMALL NUMBER OF PARTS NEEDED LEADS TO HIGH RELIABILITY. THE DISK-TYPE CONSTRUCTION FAVORS BETTER HEAT TRANSFER, SO THE LASER BEAM IS DISTORTED LESS FROM THERMAL STRESS. THE ROUND TRIP TIME FOR A LIGHT BEAM IN THE RESONATOR IS TWO ORDERS OF MAGNITUDE SMALLER THAN IN STANDARD LASERS, ALLOWING ONE TO GENERATE SHORT PULSES. THE DESIGN USES A SMALL NUMBER OF OPTICAL SURFACES, LEADING TO HIGH EFFICIENCY. THE NEW CONFIGURATION IS SUITED FOR PUMPING DIODE LASERS. IT COULD ALSO BE SCALED UP TO HIGHER POWER. THE NEGATIVE LENS LASER COULD MEASURE LASER MATERIAL PROPERTIES, SUCH AS STORED ENERGY VERSUS PUMP POWER. ITS COMPACT DESIGN ALLOWS APPLICATIONS IN COUNTER-MEASURES AND SURVEILLANCE IN AIRPLANCES AND SATELLITES. IT COULD ALSO FIND USE IN SCIENTIFIC INSTRUMENTS, MEDICAL DIAGNOSIS, AND SURGERY.

COHERENT TECHNOLOGIES INC  
PO BOX 7488  
BOULDER, CO 80306  
Program Manager: PAUL J SUNI  
Contract #:  
Title: LASER DIODE PUMPED SOLID-STATE LASER  
Topic #: SDIO90-003

Office: ID #: 40767

IN CHOOSING A WAVELENGTH FOR A LASER RADAR SYSTEM THAT COULD EXPOSE THE PUBLIC TO LASER BEAMS, ONE MUST CONSIDER EYE SAFETY. LONGER WAVELENGTHS--GREATER THAN 1.4 MICRONS, WHICH ARE LESS ENERGETIC, ARE SAFER FOR THE EYE. MUCH RESEARCH IS WORKING ON LASER RADAR FOR GREATER THAN 2 MICRONS. THIS PROJECT WILL DEVELOP SLIGHTLY SHORTER WAVELENGTHS, SUCH AS ERBIUM (ER) DOPED CRYSTALS OPERATING AT 1.5 MICRONS, WHICH CAN REACH HIGHER EFFICIENCIES--UP TO 90%. SINCE LESS ENERGY IS WASTED, THE LASERS RUN COOLER. THIS ALLOWS THE LASER TO BE SCALED UP TO HIGHER OUTPUT ENERGIES. SHORTER 1.5 MICRON WAVELENGTHS WORK BETTER WITH ENERGING FIBER OPTICS COMMUNICATIONS DEVICES. THE ATMOSPHERE ABSORBS 20 TIMES MORE OF 2.09 MICRONS WAVELENGTH THAN A 1.4-1.7 MICRON WAVELENGTH, MAKING SHORTER WAVELENGTHS MORE DESIRABLE FOR LASER RADAR. THE PROJECT WILL INVESTIGATE SEVERAL ER-DOPED AND CRE4+-DOPED



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CRYSTALS AND GLASSES. PHASE II WILL DEVELOP A COMPACT LASER DIODE CAPABLE OF PRODUCING SEVERAL MILLIJOULES PER PULSE, AT A PULSE REPETITION FREQUENCY OF 50-500 HZ. THE TECHNOLOGY CAN BE APPLIED TO LASER RADAR, RANGING, TRACKING, DETECTING WINDSHEAR OR ROCKET PLUMES, MONITORING POLLUTION, AND SPACE-BASED GLOBAL MAPPING. IT COULD ALSO SERVE IN SENSORS, AND LOCATE FAULTS IN FIBER OPTIC NETWORKS.

CREARE INC  
PO BOX 71  
HANOVER, NH 03755  
Program Manager: DR JAVIER A VALENZUELA  
Contract #:  
Title: NON-CONTAMINATING COMPRESSOR FOR CLOSED-CYCLE CRYOCOOLERS  
Topic #: SDIO90-003                      Office:                      ID #: 40760

CREARE WILL DEVELOP A HIGH PRESSURE RATIO COMPRESSOR FOR JOULE-THOMPSON CRYOCOOLERS. J-T CRYOCOOLERS USE HEAT EXCHANGERS AND EXPANSION ELEMENTS THAT ARE ORDERS OF MAGNITUDE SMALLER THEN REVERSE BRAYTON OR STIRLING CRYOCOOLERS. FURTHER J-T CRYOCOOLERS CONTAIN NO ACTIVE COMPONENTS IN THE COLD END. HENCE, THEY ARE POTENTIALLY VERY LIGHTWEIGHT AND RELIABLE. MOREOVER, J-T CRYOCOOLERS CAN BE VERY EFFICIENT. EXCLUSIVE OF THE COMPRESSOR, A ONE-STAGE J-T CAN ATTAIN 50% OF CARNOT, WHILE A 3-STAGE J-T CAN ATTAIN UP TO 75% OF CARNOT. UNFORTUNATELY, J-T CRYOCOOLERS HAVE A WEAK LINK: THE COMPRESSOR. TODAY'S HIGH PRESSURE RATIO COMPRESSORS USE LUBRICANTS AND RUBBING SEALS THAT CONTAMINATE THE COOLING SYSTEM GAS AND CAUSE THE J-T RESTRICTOR TO CLOG AND FAIL. HENCE, GAS CLEANUP SYSTEMS MUST BE INSTALLED DOWNSTREAM, BUT THEY NEED FREQUENT MAINTENANCE, AND WILL NOT FUNCTION PROPERLY IN SPACE. THIS PROJECT WILL DEVELOP A NEW COMPRESSOR THAT HAS NO RUBBING SEALS AND NEEDS NO LUBRICANTS. THUS, THIS COMPRESSOR REMOVES THE NEED FOR A GAS CLEANUP SYSTEM AND ALLOWS RELIABLE, LONG TERM OPERATION OF J-T CRYOCOOLER ATTRACTIVE CANDIDATES FOR COOLING SPACE SENSOR SYSTEMS. THE COMPRESSOR CAN ALSO SERVE IN COOLERS FOR PORTABLE NIGHT VISION SYSTEMS THAT USE ONLY A FRACTION OF A WATT. OTHER APPLICATIONS ARE CLOSED-CYCLE J-T RECONDENSERS FOR MRI SYSTEMS, AND MINIATURE REFRIGERATORS FOR SUPERCONDUCTING DEVICES.

CREARE INC  
PO BOX 71  
HANOVER, NH 03755  
Program Manager: HERBERT SIXSMITH  
Contract #:  
Title: CRYOGENIC GAS BEARINGS FOR MINIATURE TURBOMACHINES  
Topic #: SDIO90-003                      Office:                      ID #: 40812

CREARE WILL DEVELOP A GAS BEARING SYSTEM FOR USE IN MINIATURE, HIGH PERFORMANCE TURBOEXPANDERS FOR SPACEBORNE CRYOCOOLERS. THE BEARINGS WILL HAVE HIGH STABILITY AT CRYOGENIC TEMPERATURES--DOWN TO 77K, WITHOUT SIGNIFICANT LOSSES DUE TO VISCOUS DRAG, FRICTION, OR HEAT LEAKS, THUS REDUCING THE CYCLE INPUT POWER IN LOW CAPACITY CRYOCOOLERS. PHASE I WILL DEVELOP AND TEST THE BEARING SYSTEM AT CRYOGENIC TEMPERATURES, AND DEVELOP A PRELIMINARY DESIGN OF THE TURBOEXPANDER. IN PHASE II, THE TURBOEXPANDER WILL BE BUILT AND TESTED. THE GAS BEARING WILL BE BOTH STABLE AND RELIABLE AT CRYOGENIC TEMPERATURES. IT CAN SERVE IN A BROAD RANGE OF CRYOGENIC MACHINERY. THE MOST IMPORTANT APPLICATION WILL BE IN LOW CAPACITY, LOW TEMPERATURE SPACEBORNE CRYOCOOLERS, WHERE PRESENT POWER REQUIREMENTS ARE UNACCEPTABLY HIGH. THIS SPACE CRYOCOOLER TECHNOLOGY CAN DIRECTLY TRANSFER TO NASA'S SPACE PROGRAM. IT ALSO APPLIES TO SUPERCONDUCTING QUANTUM INTERFERENCE DEVICES (SQUIDS). A SQUID CAN DETECT EXTREMELY WEAK MAGNETIC FIELDS--DOWN TO 10 EXP-12 GAUSS, 1 MILLION MILLIONTH OF THE EARTH'S MAGNETIC FIELD. SQUIDS MAY AID IN MICROSURGERY, THEY CAN CHECK

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BLOOD FLOW IN ARTERIES, AND IN AIRPLANES FLYING ABOVE THE GROUND, THEY CAN DETECT MINERALS IN THE GROUND BELOW.

E-TEK DYNAMICS INC  
1885 LUNDY AVE  
SAN JOSE, CA 95131  
Program Manager: J J PAN  
Contract #:

Title: COMPOSITE BINARY MAGNETO-OPTIC LASER BEAM STEERING  
Topic #: SDIO90-003                      Office:                      ID #: 40768

ACTIVE TECHNIQUES ARE NEEDED TO HELP DISCRIMINATE TARGETS FROM DECOYS. ONE SUCH METHOD STEERS OPTICAL BEAMS TO SEVERAL DIFFERENT POINTS ON A TARGET. THIS PROJECT WILL DEVELOP A MAGNETO-OPTIC (MO) LASER BEAM STEERER. THE MO DEVICE REQUIRES LESS POWER, COSTS LESS, AND RESISTS JAMMING BETTER THAN ACOUSTIC DEVICES THAT DEFLECT LIGHT. THE MO DEVICE IS SMALL, LIGHT, TRACKS ANGLES ACCURATELY, AND SCANS RAPIDLY--GREATER THAN  $10^5$  DEGREES/SEC. IT CAN SCAN WIDE ANGLES, AND HAS A HIGH THRESHOLD TO DAMAGE. APPLYING A MAGNETIC FIELD TO A MAGNETO-OPTIC MATERIAL INCREASES THE AMOUNT THAT IT REFRACTS OR BENDS LIGHT. AN MO LASER BEAM CONTROLLER CONSISTS OF TWO MO PRISMS WITH OPPOSITE POLARITY. WHEN NO MAGNETIC FIELD IS APPLIED, THE PRISMS ARE EQUAL, ACTING LIKE TRANSPARENT GLASS, WHICH DOESN'T ALTER THE LASER BEAM'S DIRECTION. WHEN A MAGNETIC FIELD IS APPLIED, THE REFRACTIVE INDICES OF THE TWO PRISMS ARE DIFFERENT, CAUSING THE LASER BEAM TO DEFLECT. MO LASER BEAM STEERING COULD SERVE IN OPTICAL SIGNAL PROCESSING AND IMAGING, EYE PROTECTORS, HIGH-SPEED OPTICAL SWITCHES, MEDICAL DIAGNOSIS, INSTRUMENTATION, AND HELP PROTECT LASER INFRARED SENSORS. IT CAN BE MODIFIED FOR ELECTRONIC WARFARE, TACTICAL MISSILES, AND NIGHT VISION. IN LASER RADAR, IT CAN SEARCH, TRACK, AND NAVIGATE.

IRVINE SENSORS CORP  
3001 REDHILL AVE - BLDG 3/STE 208  
COSTA MESA, CA 92626  
Program Manager: JOHN C CARSON  
Contract #:

Title: NEURAL NETWORK IMPLEMENTATION FOR STRATEGIC SENSOR ENHANCEMENTS  
Topic #: SDIO90-003                      Office:                      ID #: 40817

THIS PROJECT WILL DEVELOP TECHNOLOGY FOR A SENSOR NEURAL NETWORK. THE DESIGN INTERCONNECTS THE READOUTS FROM 3-D FOCAL PLANE ARRAYS, AND ORGANIZES THE COMPONENT INTEGRATED CIRCUITS TO CREATE A MASSIVELY INTERCONNECTED PARALLEL PROCESSOR, WHICH OPERATES EXTREMELY FAST. FOR A  $256 \times 256$  PIXEL ARRAY, INTERCONNECT RATES CAN REACH  $10^{15}$  PER SECOND--ONE MILLION TIMES GREATER THAN OFF-FOCAL-PLANE DIGITAL PROCESSORS. THE NEURAL NETWORK CONSISTS OF MANY SIMPLE NONLINEAR COMPUTATIONAL ELEMENTS OPERATING IN PARALLEL. THESE COMPUTATIONAL ELEMENTS OR NODES ARE CONNECTED VIA WEIGHTED INFORMATION CHANNELS. THE WEIGHTS ARE ADAPTED DURING USE TO IMPROVE PERFORMANCE. EACH NODE TAKES THE WEIGHTED SUM OF ITS MULTIPLE INPUTS, APPLIES A NONLINEARITY TO THAT SUM, AND EMITS A SINGLE SIGNAL AS OUTPUT. "LEARNING" OCCURS BY ADJUSTING THESE WEIGHTS TO CREATE THE PROCESSES OF CLASSIFYING, FILTERING, GENERALIZING, OR OPTIMIZING. THE DESIGN USES BOTH ANALOG AND DIGITAL CIRCUITS. THE TECHNOLOGY CAN AID IN RECOGNIZING MILITARY TARGETS, IDENTIFYING CLOSELY SPACED OBJECTS, TRACKING, AND DISCRIMINATING TARGETS FROM DECOYS AND CLUTTER. APPLICATIONS INCLUDE SURVEILLANCE SENSORS, MISSILE SEEKERS, RECONNAISSANCE SYSTEMS, FIRE CONTROL SYSTEMS, ROBOTICS, AND MANUFACTURING PROCESS CONTROL.

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J.B.S. TECHNOLOGIES INC  
631 KENDALE LN  
THOUSAND OAKS, CA 91360  
Program Manager: DR JEFFREY B SHELLAN  
Contract #:  
Title: ULTRA-LIGHTWEIGHT RECEIVER APERTURES FOR SENSOR SYSTEMS  
Topic #: SDIO90-003                      Office:                      ID #: 40757

A CONVENTIONAL TELESCOPE RECEIVER COLLECTS LIGHT AND TRANSMITS IT TO A FOCAL PLANE. THIS PROJECT WILL REPLACE A CONVENTIONAL TELESCOPE RECEIVER WITH A PLASTIC SHEET THAT WEIGHS ONLY ONE-TENTH AS MUCH. THE DEVICE RECORDS A HOLOGRAM OF A CONVENTIONAL TELESCOPE ON A VERY THIN, 5 TO 10 MMM THICK, PLASTIC SHEET, WHICH IS COATED WITH A PHOTSENSITIVE RECORDING LAYER. THESE WAFER-THIN PLASTIC HOLOGRAMS CAN TRANSMIT LIGHT SIGNALS WITH VERY LITTLE NOISE. TO DEVELOP HOLOGRAPHIC REFLECTORS, PHASE I WILL SELECT PLASTICS AND PHOTOPOLYMERS THAT CAN WITHSTAND THE VACUUM AND UV RADIATION IN SPACE. THE PROJECT WILL ALSO ANALYZE HOW MUCH THE REFLECTORS WILL DISTORT FROM HEAT, HOW THE TELESCOPE SHOULD BE DESIGNED, AND HOW TO RECORD A HOLOGRAPHIC MIRROR ON THE PHOTOPOLYMER/PLASTIC LAYER. THE PROJECT WILL MEASURE THE REFLECTOR'S EFFICIENCY AND RESOLUTION. ALTHOUGH THIS TECHNOLOGY WOULD SERVE BEST IN MONOCHROMATIC (SINGLE WAVELENGTH LIGHT) SYSTEMS, SUCH AS LASER RADAR, WIDER BAND APPLICATIONS ARE FEASIBLE. ITS ULTRA-LIGHT WEIGHT MAKES THE REFLECTOR SUITABLE FOR SPACE-BASED LIDAR (LASER IMAGING RADAR) SYSTEMS. OTHER APPLICATIONS INCLUDE TARGET DESIGNATORS, REMOTE SENSORS OF GASES, AND ATMOSPHERIC SYSTEMS TO MEASURE TEMPERATURE, PRESSURE, AND WIND FIELDS TO FORECAST THE WEATHER.

LASER POWER RESEARCH  
12777 HIGH BLUFF DR  
SAN DIEGO, CA 92130  
Program Manager: GRAHAM FLINT  
Contract #:  
Title: TOMOGRAPHIC IMAGE PROFILER FOR SPACECRAFT IDENTIFICATION (TIPSI)  
Topic #: SDIO90-003                      Office:                      ID #: 40797

A MAJOR GOAL OF SDI IS TO OBTAIN HIGH RESOLUTION IMAGES THROUGH THE ATMOSPHERE. TECHNIQUES SUCH AS INTERFEROMETRY AND DEFORMABLE MIRRORS CREATE A TWO DIMENSIONAL IMAGE IN ONE STEP. EACH IMAGE DATA IS IN TWO DIMENSIONS. THIS PROJECT WILL RESOLVE IMAGES IN ONE DIMENSION ONLY. THE TECHNIQUE ENHANCES THE ANGULAR RESOLUTION IN ONE DIMENSION AT THE EXPENSE OF RESOLUTION IN THE PERPENDICULAR DIMENSION. THEN, THE DEVICE PUTS ALL THE ONE-DIMENSIONAL IMAGES TOGETHER TOMOGRAPHICALLY, IE. ONE SECTION AT A TIME, TO PRODUCE A TWO-DIMENSIONAL LASER. ONE-DIMENSIONAL IMAGES CAN REACH FAR GREATER RESOLUTION THAN THE PREVIOUS TWO-DIMENSIONAL IMAGES PRODUCED IN ONE STEP. FURTHER, THE ONE-DIMENSIONAL IMAGES CAN BE PUT TOGETHER MUCH FASTER. THIS IMAGE PROFILING TECHNIQUE CAN IMPROVE THE RESOLUTION OF GROUND-BASED TELESCOPES. IT CAN ALSO AID PRECISION SPECTRAL ANALYSIS AND IN SPECTROPHOTOMETRY - HELPING TO DETECT TRACE IMPURITIES. IT MAY PROVE VALUABLE IN FABRICATING SEMICONDUCTORS, AND CREATING SHARPER IMAGES OR BETTER ANALYSIS IN BIOLOGY, CHEMISTRY, AND MEDICINE.

MITCHELL/STIRLING MACHINES/SYSTEMS INC  
2550 NINTH ST - STE 207B  
BERKELEY, CA 94710  
Program Manager: DR LUC BAUWENS  
Contract #:  
Title: ADVANCED CRYOCOOLER FLUID

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Topic #: SDIO90-003

Office:

ID #: 40791

TYPICAL CRYOCOOLERS EMPLOY HELIUM AS A WORKING FLUID. A NEW TECHNIQUE COMBINES HELIUM AND NITROGEN AS A MIXED WORKING FLUID. AS THE CRYOCOOLER COOLS DOWN, SOME OF THE NITROGEN LIQUIFIES, REDUCING THE PRESSURE IN THE SYSTEM BECAUSE THERE'S LESS GAS. AT AMBIENT PRESSURE, NITROGEN BECOMES A LIQUID AT 77K. IN THE CRYOCOOLER, NITROGEN LIQUIFIES SOMEWHERE BETWEEN 80 AND 120K, DEPENDING ON THE PRESSURE. NITROGEN TENDS TO CONDENSE AS PRESSURE INCREASES, AND THEN EVAPORATE AS PRESSURE DECREASES. DURING EACH CYCLE, SOME NITROGEN CONDENSES AND THEN EVAPORATES. THE CYCLIC EVAPORATION AND RECONDENSATION OF NITROGEN IMPROVES HEAT TRANSFER AT OPERATING TEMPERATURES OF AROUND 80K. THE NEW TECHNIQUE CAN COOL DOWN MUCH MORE RAPIDLY FROM AMBIENT TO 80K THAN OTHER CRYOCOOLERS. THE METHOD ALLOWS A LARGER AMOUNT OF COOLING, OR THE SAME AMOUNT OF COOLING WITH GREATER EFFICIENCY. UNLIKE HELIUM CRYOCOOLERS, WHICH ARE SINGLE-PHASE, THE HE-N<sub>2</sub> CRYOCOOLERS USE THE HIGH HEAT TRANSFER FROM THE PHASE CHANGE OF NITROGEN. THE DEVICE CAN COOL ELECTRONICS, ESPECIALLY COMPUTERS AND INFRA-RED SENSORS, SUCH AS IN SATELLITES, OR MISSILE GUIDANCE. IT CAN ALSO LIQUIFY CRYOGENS, OR COOL SUPERCONDUCTORS IN MOTORS, TRANSFORMERS, GENERATORS, AND MAGNETIC LEVITATION TRAINS.

OPTRON SYSTEMS INC

3 PRESTON CT

BEDFORD, MA 01730

Program Manager: THOMAS HORSKY

Contract #:

Title: MEMBRANE LIGHT VALVE-BASED MULTI-SPECTRAL INFRARED TARGET SIMULATOR

Topic #: SDIO90-003

Office:

ID #: 40763

PHASE I WILL DEVELOP A NEW INFRARED (IR) TARGET SIMULATOR. INSTEAD OF LIQUID CRYSTALS, THE NEW IR SYSTEM WILL USE A DEFORMABLE MIRROR. THE MIRROR IS ACTUALLY A MEMBRANE THAT IS 95% REFLECTIVE. THE MIRROR CONTAINS INFORMATION. WHEN LIGHT HITS THE MIRROR, THE INFORMATION IS TRANSFERRED TO THE LIGHT. AN ELECTRON BEAM SCANS THE MIRROR TO CREATE AN IMAGE, LIKE THE SCANNING PROCESS IN A TELEVISION SET. THE SYSTEM OPERATES IN REAL TIME, PROCESSING INFORMATION AS IT RECEIVES IT. THE DEVICE DIRECTLY INTERFACES WITH A COMPUTER AND PRESENTS SIMULATED SCENES. IT OFFERS A LARGE DYNAMIC RANGE, I.E., UP TO 100 BRIGHTNESS LEVELS, HIGH CONTRAST, HIGH RESOLUTION, AND CAN SIMULATE A LARGE NUMBER OF BOTH STATIC AND FAST-MOVING TARGETS. THE DEVICE REPLACES THERMAL DEVICES, SUCH AS RESISTOR ARRAYS AND THE BLY CELL, WHICH ARE SLOWER, AND DON'T HAVE AS MANY BRIGHTNESS LEVELS NOR AS HIGH A PEAK BRIGHTNESS AS THE NEW DEVICE. THE SYSTEM WORKS IN A MUCH BROADER WAVELENGTH RANGE THAN OTHER SYSTEMS--FROM 0.18 MICRONS (UV) TO 30 MICRONS (IR). THE DEVICE IS BASICALLY A LIGHT VALVE, CHANGING LIGHT TO PRODUCE IMAGES. UNLIKE LIQUID CRYSTALS, IT'S PURELY REFLECTIVE. SINCE IT DOESN'T ABSORB LIGHT, IT CAN TOLERATE MUCH HIGHER POWER DENSITIES THAN OTHER SYSTEMS, ALLOWING ONE TO MAKE BRIGHTER DISPLAYS. IN ADDITION TO INFRARED TARGET SIMULATION, THE TECHNOLOGY CAN BE APPLIED TO SPAXIAL LIGHT MODULATORS (LIGHT VALVES) FOR OPTICAL COMPUTING, REAL-TIME PATTERN RECOGNITION, AND ADAPTIVE OPTICS FOR GROUND-BASED TELESCOPES. COMMERCIAL APPLICATIONS INCLUDE INDUSTRIAL INSPECTION AND ROBOTIC VISION. IT WORKS WELL IN OPTICAL COMMUNICATION FOR RESOLVING IMAGES IN TURBULENT MEDIA. UNLIKE OTHER DEVICES, IT CAN PRODUCE A BRIGHT DISPLAY THAT CAN BE SEEN EVEN IN DAYLIGHT.

PECKHAM ENGINEERING & TOOL

1151 - 5TH ST

MANHATTAN BEACH, CA 90266

Program Manager: R C PERPALL

Contract #:

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Title: PULSE TUBE CRYOGENIC REFRIGERATOR

Topic #: SDIO90-003

Office:

ID #: 40762

A PULSE TUBE REFRIGERATOR BASICALLY IS A VARIATION OF THE STIRLING CYCLE REFRIGERATOR, EXCEPT THE MOVING DISPLACER IS REPLACED BY A PULSE TUBE AND AN ORIFICE. THE ACTUAL COOLING TAKES PLACE AT THE LOWER END OF THE PULSE TUBE, AND HEAT IS REJECTED TO THE SURROUNDINGS AT THE UPPER END OF THE PULSE TUBE. UNLIKE THE DISPLACER, THE PULSE TUBE CONTAINS NO MOVING PARTS, LEADING TO A GREATER RELIABILITY AND MUCH LONGER LIFE - 10 YEARS OR LONGER. ON THE OTHER HAND, STERLING REFRIGERATORS TEND TO BE MORE EFFICIENT, AND REQUIRE LESS POWER THAN A PULSE TUBE. HOWEVER, THIS DESIGN WILL CONTAIN AN ORIFICE THAT CAN ACTIVELY MODULATE, OR CHANGE THE SIZE OF ITS OPENING TO IMPROVE EFFICIENCY. THE PULSE TUBE REFRIGERATOR CAN COOL DOWN TO 50 K. ITS REGENERATOR EMPLOYS MICROCHANNEL DISKS, WHICH EFFECTIVELY TRANSFER HEAT FROM THE WORKING FLUID THAT LEAVES THE COMPRESSOR TO THE WORKING FLUID THAT RETURNS TO THE COMPRESSOR. MICROCHANNEL DISKS ARE RELIABLE AND DON'T REQUIRE TIGHT TOLERANCES TO WORK. PULSE TUBE REFRIGERATORS CAN COOL LONG WAVELENGTH INFRARED SENSORS, AND CRYOGENIC FLUID TANKS, SUCH AS LIQUID NITROGEN AND HYDROGEN. THEY CAN ALSO CONTROL THE ENVIRONMENT OF SUPERCONDUCTING MATERIALS, AND PROVIDE REFRIGERATION FOR LABORATORIES AND HOSPITALS.

PHYSICAL OPTICS CORPORATION

2545 W. 237TH STREET, SUITE B

TORRANCE, CA 90505

Program Manager: DR. LIN

Contract #:

Title: INTEGRATED WAVEGUIDE HOLOGRAPHIC ELEMENT ARRAY LASER WARNING DEVICES

Topic #: SDIO90-003

Office:

ID #: 10000

A PULSE-FORMING LINE (PFL) IS LIKE A LONG STRUNG-OUT CAPACITOR. THE PULSE, WHICH TRAVELS DOWN THE LINE, CAN BE USED TO PUMP A LASER OR DRIVE A PARTICLE BEAM ACCELERATOR. A PFL CONSISTS OF 2 CONDUCTING TUBES, ONE INSIDE THE OTHER, WITH A DIELECTRIC BETWEEN THEM. MOST LABORATORY PFLS USE WATER AS A DIELECTRIC BECAUSE OF ITS HIGH DIELECTRIC CONSTANT (80), AND GOOD DIELECTRIC STRENGTH. HOWEVER, WATER MUST BE CONSTANTLY FILTERED AND DEIONIZED, MAKING IT IMPRACTICAL FOR USE ON A SPACECRAFT. THIS PROJECT WILL DEVELOP A SOLID DIELECTRIC PFL WHICH NEEDS NO MAINTENANCE. UNFORTUNATELY, SOLID PFLS HAVE A LOW DIELECTRIC CONSTANT, WHICH LEADS TO LONG LINES. THIS PROJECT WILL COMPACT THE PFLS INTO SMALL SPACES BY FOLDING THE PFL. THE PFL IS DESIGNED SUCH THAT THE PROPAGATING WAVE CAN BE TRANSMITTED AROUND A CORNER WITHOUT DISTORTING. TO DO THIS, THE PROJECT WILL DEVELOP A SPECIAL POLYMER, WHICH IS LIGHTWEIGHT, FLEXIBLE, RUGGED, AND HAS HIGH DIELECTRIC STRENGTH. THE SYSTEM CAN PROVIDE PULSED POWER FOR WEAPONS ON AIRCRAFT AND ON SPACECRAFT. IT CAN ALSO BE USED IN PULSED GENERATORS FOR X-RAYS, AND PULSED ELECTRIC LASERS. IT CAN CREATE A FOCUSED SHOCK FOR DRILLING OIL WELLS, WHICH IS FASTER AND MORE EFFICIENT THAN ORDINARY DRILLING.

Q-DOT INC

1069 ELKTON DR

COLORADO SPRINGS, CO 80907

Program Manager: DR STEPHEN D GAALEMA

Contract #:

Title: LOW-POWER FLOATING-POINT ANALOG-TO-DIGITAL CONVERTER

Topic #: SDIO90-003

Office:

ID #: 40766

TO PERFORM TASKS EFFECTIVELY IN VARYING CONDITIONS, SDI NEEDS SENSORS WHICH SPAN WIDE RANGES. GENERALLY, ANALOG SENSORY DATA IS CONVERTED TO A DIGITAL FORM FOR PROCESSING.

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THIS PROJECT WILL DEVELOP A FLOATING-POINT ANALOG-TO-DIGITAL (A/D) CONVERTER WHICH CAN INTERFACE SENSORS TO PROCESSORS. THE CONVERTER CAN SPAN A BROAD RANGE OF SIGNAL AMPLITUDES. TO RESOLVE A SIGNAL TO 1% OVER A 110:1 RANGE THE NEW A/D CONVERTER CAN DO THE JOB WITH 11-BITS, COMPARED TO AN ORDINARY CONVERTER WHICH REQUIRES 14-BITS. THE NEW A/D CONVERTER NEEDS A MAXIMUM RESOLUTION OF ONE PART IN 256, VERSUS ONE PART IN 16,384 FOR A LINEAR 14-BIT A/D. HENCE, THE NEW A/D CONVERTER IS SMALLER, FASTER, AND CONSUMES LESS POWER. THE SMALL SIZE AND LOW POWER CONSUMPTION ALLOWS THESE A/D TO BE READILY INTEGRATED WITH OTHER FUNCTIONS, SUCH AS IMAGERS, FILTERS, SIGNAL CONDITIONERS, AND DIGITAL MEMORY PROCESSORS—RIGHT ON THE SAME CHIP. THE A/D CAN BE INTEGRATED WITH THE SENSOR ITSELF. THE A/D CONVERTER IS COMPATIBLE WITH MODERN MICROPROCESSORS. IT COSTS LESS, YET INCREASES PRECISION AND RESPONSE. IT CAN SERVE IN ROBOTS TO IMPROVE PERFORMANCE, WHILE REDUCING COST AND COMPLEXITY. Q-DOT WILL ALSO MAKE A LOW-POWER, LINEAR A/D CONVERTER THAT CAN BE USED AT CRYOGENIC TEMPERATURES—DOWN TO 40K.

SCIENCE RESEARCH LAB INC  
15 WARD ST  
SOMERVILLE, MA 02143  
Program Manager: DR JONAH JACOB  
Contract #:

Title: XENON-FLUORIDE LASERS FOR RADAR APPLICATIONS  
Topic #: SDIO90-003                      Office:                      ID #: 40771

A PULSED XENON FLUORIDE (XEF) LASER CAN BE TUNED OVER A RANGE OF WAVELENGTHS FROM 450 TO 500 NM. REPLACING THE GAS FLOW LOOP WITH A SEALED, CONDUCTION-COOLED HEAD MODULE MAKES THE DEVICE MORE COMPACT AND LIGHTER. POWER OUTPUT CAN BE TAILORED BY STACKING LASER MODULES. THE GOAL: A 200 WATT LASER THAT FITS INSIDE 0.25 M AND WEIGHS ONLY 125 KG. THE DEVICE CAN BE USED IN LASER IDENTIFICATION AND RANGING. IT IS SUITABLE FOR SPACE AND OTHER SIZE OR SPACE-CONSTRAINED APPLICATIONS. THE BLUE-GREEN OUTPUT OF XEF PERMITS THE BEAM TO BE PASSED THROUGH SEA WATER, AND CAN BE USED IN LASER MEDICINE, SINCE THE HUMAN BODY PRIMARILY CONSISTS OF SALT WATER. A XEF LASER CAN ALSO CUT METAL, SEPARATE OUT URANIUM ISOTOPES, AND ACT AS A PLASMA SOURCE FOR X-RAY LITHOGRAPHY. INCORPORATING A GAS FLOW LOOP FROM A CONVENTIONAL GAS LASER ALLOWS THE POWER OF THE DEVICE TO BE INCREASED EVEN MORE, BUT IT ADDS CONSIDERABLE WEIGHT AND SIZE.

SINHA S & ASSOCS INC  
PO BOX 11205  
BURBANK, CA 91510  
Program Manager: SACH SINHA  
Contract #:

Title: ULTRAVIOLET DETECTION OF DARK BODIES AGAINST EARTH'S BACKGROUND  
Topic #: SDIO90-003                      Office:                      ID #: 40803

THIS PROJECT WILL DEVELOP A NEW METHOD FOR DETECTING DARK BODIES IN SPACE, AGAINST A BACKGROUND OF THE EARTH'S AIRGLOW AND AURORA. A DARK BODY IS COLD, I.E. IT DOES NOT EMIT MUCH INFRARED (IR) RADIATION. HENCE, ONE CANNOT USE IR SENSORS TO DETECT DARK BODIES. THIS TECHNOLOGY CAN DETECT A BODY IN SPACE WITHOUT FIRST NEEDING TO DETECT ITS PLUME. THE PROJECT WILL CALCULATE THE SIGNAL-TO-NOISE RATIO FOR VARIOUS TARGET/SENSOR LOCATIONS, TARGET CONFIGURATIONS, REFLECTIVITY OF TARGETS, AND BACKGROUND/FOREGROUND AIRGLOW INTENSITIES. THE SIGNAL-TO-NOISE RATIO IS A MEASUREMENT OF HOW GOOD A DETECTOR IS. A GOOD DETECTOR IS ONE THAT CAN PICK OUT A SIGNAL IN A VERY NOISY ENVIRONMENT. THIS TECHNIQUE HAS PRIMARILY MILITARY APPLICATIONS, BUT IT CAN ALSO SERVE AS A PASSIVE UV SENSOR TO DETECT AND TRACK OBJECTS IN SPACE. A PASSIVE SENSOR MEANS IT RECEIVES ONLY; IT DOES NOT TRANSMIT. FOR EXAMPLE, RADAR IS AN ACTIVE SENSOR; IT BOTH TRANSMITS AND RECEIVES, WHEREAS UV AND IR

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SENSORS ONLY RECEIVE.

**SUPERCONDUCTOR TECHNOLOGIES INC**

460 WARD DR - STE F

SANTA BARBARA, CA 93111

Program Manager: DR WILLIAM L OLSON

Contract #:

Title: THALLIUM THIN-FILM SUPERCONDUCTING QUANTUM INTERFERENCE DEVICES

Topic #: SDIO90-003

Office:

ID #: 40765

THIS STUDY IDENTIFIES ONE OR MORE TECHNIQUES FOR PRODUCING HIGH TEMPERATURE SUPERCONDUCTING QUANTUM INTERFERENCE DEVICES (SQUIDS), BY CREATING A WEAK LINK IN THE GRAIN BOUNDARY. ACCORDING TO PREVIOUS STUDIES, THALLIUM-BASED SUPERCONDUCTORS PRODUCE HIGHLY SENSITIVE SQUIDS. HOWEVER, IN THESE PRIOR STUDIES, THE SQUIDS HAD RANDOM GRAIN BOUNDARIES, AND FILMS WITH A LOT OF DEFECTS. THIS NEW APPROACH WILL FORM AND THEN MEASURE THE BEHAVIOR OF SQUIDS MADE FROM HIGH-QUALITY THALLIUM-BASED THIN FILMS WITH INTENTIONALLY CREATED DEFECTS. THIS METHOD SHOULD INCREASE SQUID SENSITIVITY BECAUSE IT REDUCES THE MAGNETIC FLUX MOTION IN THE FILM, THEREBY MINIMIZING THE BACKGROUND NOISE. IT ALSO STRUCTURES THE GRAIN BOUNDARIES, SO THEY ARE NOT RANDOM, FOR GREATER SENSITIVITY. SQUIDS CAN DETECT MAGNETIC FIELDS, LEADING TO APPLICATIONS IN SUBMARINE DETECTION, UNDERSEA COMMUNICATION, MINERAL EXPLORATION, WELL LOGGING, AND NON-DESTRUCTIVE TESTING. THEY CAN ALSO BE USED IN MAGNETO-CARDIOGRAPHY, MAGNETO-ENCEPHALOGRAPHY, AND OTHER MEANS OF NON-INVASIVE MEDICAL DIAGNOSIS.

**XACTON CORP**

PO BOX 3129

TEMPE, AZ 85280

Program Manager: BAL K JINDAL

Contract #:

Title: MERCURY CADMIUM TELLURIDE FOR LONG WAVELENGTH (15-25 MICRONS) INFRARED SENSOR APPLICATIONS

Topic #: SDIO90-003

Office:

ID #: 40758

XACTON DEVELOPED A NEW PROCESS TO PRODUCE HIGH QUALITY SINGLE CRYSTALS OF MERCURY CADMIUM TELLURIDE WITH POSSIBLE USE IN INFRARED SENSORS AND FOCAL PLANE ARRAYS OVER NEARLY THE ENTIRE INFRARED SPECTRUM. THIS PROCESS ALREADY SUCCEEDED IN THE 10 MICRON RANGE AND TO A LIMITED EXTENT IN THE 15-16 MICRON RANGE. THIS PROJECT WILL DETERMINE IF THIS PROCESS IS FEASIBLE FOR GROWING MERCURY CADMIUM TELLURIDE FOR USE IN THE 15-25 MICRONS RANGE, WHICH SDI NEEDS FOR DIM COLD TARGETS AND HIGH SENSITIVITY AREAS. THIS TECHNOLOGY CAN PRODUCE INFRARED FOCAL PLANE ARRAYS FOR VARIOUS DEFENSE APPLICATIONS, SUCH AS SURVEILLANCE, TARGET DETECTION, TRACKING, MISSILE GUIDANCE, THERMAL IMAGING, NAVIGATION, AND NIGHT VISION. COMMERCIAL APPLICATIONS INCLUDE FIBER OPTICS, MEDICAL, AND SCIENTIFIC INSTRUMENTS.

**CRYSTALLUME**

125 CONSTITUTION DR

MENLO PARK, CA 94025

Program Manager: WILSON SMART

Contract #:

Title: CHEMICAL VAPOR DEPOSITION DIAMOND COATINGS FOR IMPROVED THERMIONIC POWER SYSTEMS

Topic #: SDIO90-004

Office:

ID #: 40777

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DIAMOND THIN FILMS CAN GREATLY INCREASE THE EFFICIENCY OF A THERMIONIC ENERGY CONVERTER (TEC). A TEC CONVERTS HEAT INTO ELECTRICITY. THIS PROJECT WILL DEVELOP A DIAMOND-COATED CATHODE FOR A TEC. WITH DOPING, ONE CAN ADJUST THE WORK FUNCTION OF DIAMOND FROM 0 TO 5 VOLTS. THE WORK FUNCTION IS THE ENERGY NECESSARY TO KICK OFF ELECTRONS FROM THE SURFACE. IN A TEC, THE HOT SIDE, OR CATHODE, EMITS ELECTRONS, WHILE THE COLD SIDE, OR ANODE, GATHERS ELECTRONS. DIAMOND IS THE BEST KNOWN CONDUCTOR OF HEAT--WITH A THERMAL CONDUCTIVITY 50% GREATER THAN COPPER. HENCE, DIAMOND LOWERS THE EMITTER RESISTANCE OF THE CATHODE, LEADING TO GREATER EFFICIENCY. DIAMOND IS ALSO THE ONLY KNOWN MATERIAL WITH A BULK NEGATIVE ELECTRON AFFINITY, ALLOWING IT TO READILY EMIT ELECTRONS. IN ADDITION, DIAMOND RESISTS THERMAL SHOCK, RADIATION, AND CHEMICAL ATTACK, SO DIAMOND-COATED THERMIONIC ELECTRODES WILL EXTEND THE LIFE AND IMPROVE THE RELIABILITY OF TECs. THIS TEC IS DESIGNED TO GENERATE POWER FOR SATELLITES. IN THE SYSTEM, NUCLEAR FUEL HEATS UP A CATHODE, CAUSING ELECTRONS TO BUBBLE OFF. THE NUCLEAR POWERED SYSTEM CAN GENERATE MORE POWER THAN SOLAR CELLS. FURTHER, THE DIAMOND-COATED CATHODES DON'T NEED ANY SHIELDING, BECAUSE DIAMOND CAN WITHSTAND A LOT OF RADIATION WITHOUT A LOSS IN PERFORMANCE. DIAMOND-COATED CATHODES COULD ALSO FIND USE IN TERRESTRIAL POWER PLANTS, AND EVEN IN TELEVISION SETS. DIAMOND COATINGS COULD SERVE IN LASER TUBES, NUCLEAR-PUMPED FREE ELECTRON LASERS, PULSED ELECTRON BEAM SUPPLIES, AND LARGE AREA CATHODES. NORMALLY, A HOT FILAMENT CAN'T EMIT ELECTRONS OVER A LARGE AREA, BECAUSE IT'S DIFFICULT TO HEAT UP THE WHOLE AREA. HOWEVER, DIAMOND COULD BE RUN AS A COLD CATHODE, ALLOWING IT TO EMIT ELECTRONS OVER A BROAD AREA.

CRYSTALLUME

125 CONSTITUTION DR  
MENLO PARK, CA 94025

Program Manager: WILSON SMART

Contract #:

Title: DIAMOND COATING AND MODERATOR FOR NUCLEAR FUEL PELLETS

Topic #: SDIO90-004

Office:

ID #: 40778

TYPICAL NUCLEAR FUEL PELLETS ARE COATED WITH A GRAPHITE MODERATOR, ENCLOSED IN SILICON CARBIDE CLADDING THAT PREVENTS RADIATION FROM LEAKING OUT. A MODERATOR IS A SUBSTANCE THAT SLOWS DOWN FAST NEUTRONS, SO AS TO INCREASE THE LIKELIHOOD OF FISSION. THIS PROJECT WILL CLAD NUCLEAR FUEL PELLETS WITH HYDROGEN-RICH DIAMOND-LIKE CARBON (DLC), WHICH WILL SERVE AS BOTH CLADDING AND MODERATOR. HYDROGEN IS A MORE EFFICIENT MODERATOR THAN GRAPHITE BECAUSE IT IS MORE NEARLY THE SAME SIZE AS A NEUTRON. IF A PING PONG BALL HITS A BOWLING BALL, IT BOUNCES OFF WITH ALMOST THE SAME VELOCITY AS IT STARTED, BUT IF IT HITS ANOTHER PING PONG BALL, IT WILL SLOW DOWN. UNLIKE OTHER CLADDING MATERIALS, HYDROGEN CAN BE STORED AT HIGH CONCENTRATIONS IN DLC, BY THE PROCESS OF PLASMA-ENHANCED CHEMICAL VAPOR DEPOSITION. THE HYDROGEN-RICH DLC LAYER IS OVERCOATED WITH PURE DIAMOND, WHICH ACTS AS AN IMPERMEABLE ENCAPSULATING MATERIAL. THE DESIGN PROVIDES COMPACT, RAPID-START FISSION REACTORS THAT CAN OPERATE IN SPACE. THE TECHNOLOGY LEADS TO MORE EFFICIENT MODERATOR MATERIALS FOR COMMERCIAL REACTORS. IT COULD ALSO LEAD TO MORE ROBUST CLADDING, WHICH WOULD BOTH MODERATE NEUTRONS AND RAPIDLY TRANSFER HEAT, THEREBY INCREASING REACTOR EFFICIENCY.

RASOR ASSOCS INC

253 HUMBOLDT CT  
SUNNYVALE, CA 94089

Program Manager: DR G L HATCH

Contract #:

Title: PARTIAL RADIATION INSULATED DIODES FOR SPACE POWER APPLICATIONS

Topic #: SDIO90-004

Office:

ID #: 40780



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THERMIONIC NUCLEAR REACTORS CAN SUPPLY ENERGY TO SPACE SYSTEMS THAT REQUIRE LOW POWER AND LONG LIFE. THERMIONIC CONVERTERS ARE STATIC DEVICES THAT CONVERT HEAT DIRECTLY INTO ELECTRICITY. THE NUCLEAR FUEL CLADDING SERVES AS THE EMITTING ELECTRODE, AND IS SURROUNDED WITH CLOSE SPACING BY THE COLLECTOR ELECTRODE. THE STABILITY AND LIFETIME OF THE SYSTEM DEPEND ON MAINTAINING THE PROPER GAP BETWEEN THE ELECTRODES. THIS PROJECT WILL MODIFY THE PRESENT DESIGN OF THE THERMIONIC FUEL ELEMENT (TFE), BY SHIELDING A PORTION OF THE EMITTER. THIS REDUCES THE AREA WHERE THERMAL RADIATION CAN BE EMITTED. THE DEVICE CAN MAINTAIN THE OUTPUT POWER, YET REDUCE THE FUEL POWER DENSITY, WHICH LESSENS THE DISTORTING OF THE FUEL AND EMITTER. DISTORTION CAN DROP FROM AS 4% TO AS LITTLE AS 1%, WHICH INCREASES THE LIFETIME OF THE SYSTEM. IT CAN ALSO DECREASE LOSSES DUE TO RESISTANCE, ALLOWING LONGER CELLS. FURTHER, SINCE THIS DESIGN OPERATES AT LOWER TEMPERATURES, IT ELIMINATES THE NEED FOR THE DRIVER FUEL AND RADIATORS. ON THE OTHER HAND, THE EFFICIENCY DROPS FROM ROUGHLY 11% TO 10%. NONETHELESS, THE SYSTEM SAVES COST, WEIGHT, SPACE, AND LASTS LONGER. THE PRINCIPLE CAN CONVERT HEAT TO ELECTRICITY IN SOLAR ENERGY SYSTEMS, AND FOSSIL FUEL POWER PLANTS.

ASTRO-POWER INC (ASTROSYSTEMS)  
30 LOVETT AVE  
NEWARK, DE 19711

Program Manager: JEROME S CULIK

Contract #:

Title: HIGH-PERFORMANCE RADIATION-HARD ULTRA-THIN SILICON-UNDER-GLASS SOLAR CELLS

Topic #: SDIO90-005

Office:

ID #: 40754

THIS PROJECT WILL BOND SILICON DIRECTLY TO GLASS, THEN THIN THE SILICON WITH A CHEMICAL ETCHANT TO AS LITTLE AS 10 MICRONS THICK, CREATING AN ULTRA-THIN SILICON SOLAR CELL. THE GLASS FUNCTIONS AS BOTH THE MECHANICAL SUPPORT AND THE COVER. THE ULTRA-THIN SILICON LAYER IS LESS LIKELY TO BE HIT BY ONCOMING RADIATION, EXTENDING ITS LIFE IN SPACE. AN ORIENTATION-DEPENDENT ETCHANT ACTS TO MICROMACHINE THE SILICON TO A GROOVED SURFACE, THEN THE PROCESS DEPOSITS A BACK SURFACE REFLECTOR. ENTERING LIGHT HITS THE BACK REFLECTOR, AND BOUNCES OFF IN SUCH A WAY THAT IT IS TOTALLY INTERNALLY REFLECTED WHEN IT HITS THE FRONT PLANAR SURFACE. THIS TRAPS THE LIGHT, INCREASING ITS OPTICAL PATH TO 20 TIMES GREATER THAN THE BASE THICKNESS. THIS IMPROVES THE EFFICIENCY TO MORE THAN 16%, HALF AGAIN GREATER THAN STANDARD SILICON SOLAR CELLS. SILICON IS ELECTROSTATICALLY BONDED TO THE GLASS - WITHOUT ADHESIVES, SO UV RADIATION WILL NOT AFFECT IT. THIS DESIGN CREATES A SOLAR CELL WITH A HIGH POWER PER UNIT WEIGHT. THE ELECTROSTATIC BONDING METHOD CAN BE APPLIED TO CONVENTIONAL SOLAR CELLS, MICROSENSORS, MICROACTUATORS, AND VACUUM MICROELECTRONIC DEVICES. THE HIGH TEMPERATURE CONTACT CAN SERVE IN SILICON CONCENTRATOR SOLAR CELLS, HIGH-POWER RECTIFIERS, DIODES, AND INTEGRATED CIRCUITS.

ASTROPOWER, INC.  
30 LOVETT AVENUE  
NEWARK, DE 19711

Program Manager: MS. COLLINS

Contract #:

Title: INDIUM-PHOSPHIDE SOLAR CELL FOR FLAT PLATE SPACE POWER MODULES

Topic #: SDIO90-005

Office:

ID #: 50000

THIS PROJECT WILL DESIGN A SIMPLE, HYDRAZINE MICRO-ELECTRIC PROPULSION (MEP) THRUSTER TO REPLACE THE HYDRAZINE CHEMICAL THRUSTERS NOW USED TO CONTROL THE ATTITUDE, OR ORIENTATION, OF MINIATURE SPACECRAFT. THE MEP THRUSTER COULD SAVE WEIGHT, FUEL, AND INCREASE MISSION FLEXIBILITY, SUCH AS ENABLING THE CRAFT TO WORK IN BOTH HIGH AND LOW ORBITS. THE NEW DESIGN RAISES THE ENERGY DENSITY, AND IMPROVES EFFICIENCY. MEP TECHNOLOGY COULD

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ENHANCE THE SPACECRAFT'S ABILITY TO MANEUVER, AND INCREASE ITS LIFETIME. THIS WOULD CUT SPACECRAFT REPLACEMENT COSTS, AND REDUCE SERVICES NEEDED TO MAINTAIN THE LAUNCH VEHICLES. THIS PROJECT WILL ALSO INVESTIGATE HOW THE MEP OPERATES, AND WHAT IS REQUIRED TO INTEGRATE THE MEP THRUSTER INTO A SPACECRAFT. IN ADDITION TO SDI, THE MEP THRUSTER COULD EXTEND THE LIFE AND INCREASE THE PAYLOAD OF MANY SMALL SATELLITES.

BAYLESS J R CO  
20325 SEABOARD RD  
MALIBU, CA 90265  
Program Manager: JOHN R BAYLESS  
Contract #:  
Title: HIGH VOLTAGE DESIGN CONCEPTS FOR SPACE APPLICATIONS  
Topic #: SDIO90-005                      Office:                      ID #: 40804

THE INTERACTIONS OF HIGH-VOLTAGE SPACE-BASED STRATEGIC DEFENSE SUBSYSTEMS WITH THE GAS, PLASMA, MICROMETEORS, SPACE DEBRIS, AND RADIATION CAN CAUSE ELECTRICAL BREAKDOWN, ARCING, AND PLASMA DISCHARGE. THIS COULD IMPERIL MAJOR PORTIONS OF ENTIRE SYSTEMS. THIS PROJECT WILL ATTEMPT TO MITIGATE THESE PROBLEMS, WHILE MINIMIZING SYSTEM WEIGHT. THE FIRST APPROACH USES LIGHT-WEIGHT METAL SHROUDS TO ISOLATE INSULATORS FROM THE PLASMA. THE SECOND APPROACH EMPLOYS SEMICONDUCTIVE COATINGS TO ELECTROSTATICALLY GRADE INSULATOR SURFACES AND TO BLEED-OFF CHARGE DEPOSITED BY THE PLASMA. THE THIRD APPROACH USES ION IMPLANTATION OR ELECTRON BEAMS TO FORM CONDUCTIVE SURFACE LAYERS ON POLYMER INSULATORS, THEREBY ALLOWING ELECTROSTATIC GRADING AND CHARGE BLEED-OFF. THESE ABOVE METHODS SHOULD MINIMIZE HIGH-VOLTAGE PROBLEMS IN DEVICES SUCH AS NEUTRAL PARTICLE ACCELERATORS, ELECTROMAGNETIC GUNS, FREE-ELECTRON LASERS, ELECTRON BEAMS, LASER RADARS, AND HIGH POWER MICROWAVE GENERATORS. SPECIFICALLY, THE INSULATION METHODS COULD PROTECT HIGH VOLTAGE, LEADS, SWITCHES, TRANSFORMER LEADS, CATHODES, CAPACITOR TERMINALS, AND BATTERY TERMINALS. THE METHODS COULD ALSO HELP HIGH POWER COMMUNICATION SATELLITES AND LASER IMAGING RADAR SYSTEMS FOR GLOBAL WIND MAPPING.

CRYSTECO INC  
180 E MAIN ST  
WILMINGTON, OH 45177  
Program Manager: RICHARD H DEITCH  
Contract #:  
Title: LARGE DIAMETER LOW DISLOCATION DENSITY GERMANIUM SUBSTRATES  
Topic #: SDIO90-005                      Office:                      ID #: 40756

LARGE-AREA GAAS SOLAR CELLS IMPROVE EFFICIENCY AND POWER OVER SILICON CELLS; GAAS CAN ALSO BETTER RESIST RADIATION. SINCE HIGH-QUALITY LARGE-AREA SINGLE-CRYSTAL GAAS IS NOT YET AVAILABLE, THIS PROJECT WILL DEPOSIT EPITAXIAL LAYERS OF GAAS ONTO A GERMANIUM SUBSTRATE TO FORM GAAS/GE. GAAS/GE CAN WITHSTAND MORE IMPACT BEFORE FRACTURING THAN GAAS ALONE. THIS PROJECT WILL EMPLOY THE CZOCHRALSKI (CZ) METHOD TO GROW SINGLE CRYSTALS OF GERMANIUM. THE CZ METHOD CAN GROW HIGH PURITY CRYSTALS WITH FEW DISLOCATIONS, AND WITH A DIAMETER GREATER THAN 100 MM, A 30 TO 50% INCREASE OVER OTHER METHODS. IN THE CZ PROCESS, ONE INSERTS SMALL SEED CRYSTALS OF GERMANIUM, SILICON, OR ANOTHER SEMICONDUCTOR INTO A CRUCIBLE FITTED WITH A SIMILAR MOLTEN MATERIAL, THEN SLOWLY PULLS THE SEED UP FROM THE MOLT WHILE ROTATING IT. THE CZ METHOD ALLOWS GAAS/GE SOLAR CELLS TO BE MADE WITH THE SAME EQUIPMENT NOW FABRICATING COMMERCIAL SILICON CELLS, WHICH SUBSTANTIALLY REDUCES PRODUCTION COSTS. DURING THE CZ PROCESS, SCUM MAY FORM ON THE MELT SURFACE, WHICH ADVERSELY AFFECTS THE QUALITY OF THE CRYSTAL. THIS PROJECT WILL LOOK FOR WAYS TO PREVENT OR REMOVE THIS SCUM. GAAS/GE WAFERS MAY ALSO SERVE IN INSTRUMENTATION AND COMPUTERS.

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ESPECIALLY IN SPACE.

INNOVATIVE SOLUTIONS FROM ADVANCED TECH

7375 BOSTON BLVD - STE 110

SPRINGFIELD, VA 22153

Program Manager: ERNEST BLASE

Contract #:

Title: HIGH SPECIFIC POWER/ENERGY RECHARGEABLE BATTERY CONCEPT

Topic #: SDIO90-005

Office:

ID #: 40755

AN ALKALI BATTERY WILL BE DEVELOPED THAT CAN SUPPLY THE HIGH SPECIFIC ENERGY AND POWER NEEDED FOR MISSIONS IN SPACE. THE PROPOSED APPROACH OFFERS HIGH ENERGY PER UNIT MASS (SPECIFIC ENERGY), COMPARABLE TO THE BEST RECHARGEABLE LITHIUM BATTERIES CURRENTLY UNDER DEVELOPMENT, WHILE IT SUBSTANTIALLY INCREASES THE AMOUNT OF POWER PER UNIT WEIGHT (SPECIFIC POWER). PHASE 1 WILL ANALYZE THE FEASIBILITY OF THE CONCEPT. PHASE 2 WILL BUILD AND TEST A PROTOTYPE BATTERY. THIS NEW ALKALI BATTERY COULD STORE ENERGY IN MANY SPACECRAFT, THE ELECTRIC HALE AIRPLANE, ELECTRIC CARS, AND SUBMARINES.

TETRA CORPORATION

4905 HAWKINS STREET, NE

ALBUQUERQUE, NM 87109

Program Manager: MR. MOENY

Contract #:

Title: VERY COMPACT FOLDED SOLID DIELECTRIC PULSE-FORMING LINE

Topic #: SDIO90-005

Office:

ID #: 30000

THE ADVANTAGES OF SUPERCONDUCTING PROCESSING CIRCUITRY FOR INFRARED FOCAL PLANE ARRAYS INCLUDE LOW POWER CONSUMPTION AND THE POSSIBILITY OF PLACING PROCESSING CIRCUITRY ON THE SAME SUBSTRATE AS THE DETECTORS. THE PAYOFF OF THIS CONFIGURATION IS A GREAT REDUCTION IN THE NUMBER OF LEADS COMING OFF THE SUBSTRATE, A REDUCTION IN COOLING POWER REQUIREMENTS, A REDUCED SYSTEM VOLUME AND FASTER SIGNAL PROCESSING. THE FABRICATION PROCESS WILL ALSO BE CHEAPER AND SIMPLER BECAUSE BONDING OF LEADS TO THE SUBSTRATE WILL BE MINIMIZED. AMPLIFICATION IN SUPERCONDUCTING ELECTRONICS IS PERFORMED BY THE THIN-FILM SQUID (SUPERCONDUCTING QUANTUM INTERFERENCE DEVICE). SQUID AMPLIFIERS HAVE MUCH LOWER INPUT NOISE THAN SEMICONDUCTING AMPLIFIERS, WHICH CAN ENHANCE THE SENSITIVITY OF THE AMPLIFIED DEVICE, SUCH AS AN INFRARED DETECTOR. SQUID AMPLIFIERS OPERATE AT VERY LOW POWER LEVELS, TYPICALLY 1 NANOWATT, WHICH REQUIRES LESS COOLING POWER AND THEREFORE LESS SYSTEM WEIGHT AND VOLUME THAN CONVENTIONAL AMPLIFIERS. THIS FACTOR IS ESPECIALLY ADVANTAGEOUS AND COST-REDUCING FOR SPACE APPLICATIONS. THE INFRARED DEVICE/SQUID AMPLIFIER CHIPS CAN BE USED IN INFRARED IMAGING ARRAYS FOR SPACE OR OTHER APPLICATIONS. THE AMPLIFIERS MAY ALSO BE USED FOR VERY HIGH SENSITIVITY MICROWAVE AND MILLIMETER WAVE DETECTORS. THE LOW COST AND HIGH YIELD OF SUPERCONDUCTING INFRARED IMAGING ARRAYS WILL OPEN UP COMMERCIAL APPLICATIONS WHERE THE COST IS NOW PROHIBITIVE.

ELECTRIC PROPULSION LABORATORY, INC.

43423 DIVISION STREET, SUITE 205

LANCASTER, CA 93535

Program Manager: DR. ASTON

Contract #:

Title: MICRO ELECTRIC PROPULSION THRUSTER

Topic #: SDIO90-006

Office:

ID #: 40000

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THIS PROJECT WILL DEVELOP SENSORS, WHICH CAN WARN OF A LASER ATTACK. THE DEVICE SENSES BOTH THE DIRECTION AND AMOUNT OF POWER EMITTED BY THE LASER. THIS DEVICE IS MUCH SMALLER (ONLY ONE SQUARE INCH) THAN PREVIOUS LASER WARNING SYSTEMS, MAKING IT HARDER FOR AN ENEMY TO SEE. IT ALSO OPERATES AT SEVERAL DISCRETE WAVELENGTHS WITH BETTER ANGULAR RESOLUTION (ADJUSTABLE FROM 1.0 DEGREE TO 0.01 DEGREES), AND OVER A WIDER FIELD OF VIEW (120 DEGREES). THE DEVICE REQUIRES VERY LITTLE POWER. ONE CAN ADJUST THE RECEIVING POWER SENSITIVITY TO PREVENT THE DETECTORS FROM BECOMING SATURATED. ONLY LIGHT OF THE DESIRED WAVELENGTH WILL ENTER THE WAVEGUIDE AND PROPAGATE TO THE DETECTOR. FURTHER, THE LASER WARNING CHIP CAN BE MADE WITH A MULTIPLEXED HOLOGRAM, WHICH CAN DETECT MULTIPLE WAVELENGTHS. THIS LIGHT SENSING TECHNOLOGY CAN COMBINE WITH FOCAL PLANE ARRAY TECHNOLOGY TO PRODUCE A DEVICE THAT CAN SENSE, IMAGE, AND PROCESS DATA. THIS TECHNOLOGY CAN ALSO FIND APPLICATIONS IN RANGE MEASUREMENT, HIGH-PRECISION DIRECTIONAL AND SPECTRAL FINDERS, AND OTHER OPTICAL SENSOR DEVICES. ITS HIGH EFFICIENCY AND ITS ABILITY TO COUPLE WAVEGUIDES WITH FIBERS ALLOWS IT TO BE USED IN OPTICAL SIGNAL PROCESSING AND OPTICAL COMMUNICATIONS.

SPACE POWER INC  
621 RIVER OAKS PKWY  
SAN JOSE, CA 95134  
Program Manager: SEE-POW WONG  
Contract #:  
Title: COORDINATED FUSE-CONTROLLER SYSTEM FOR MULTIPLE ARCJET OPERATION  
Topic #: SDIO90-006                      Office:                      ID #: 40799

A NEW SYSTEM FOR MANAGING ARCJET THRUSTER OPERATION IS BEING DEVELOPED FOR SPACECRAFT ORBIT LIFTING WHERE AUTOMATIC SWITCHING TO MULTIPLE BACKUP THRUSTERS IS REQUIRED. THE SYSTEM COMBINES PROPELLANT FUEL CONTROL AND FUSE LINKS TO ELIMINATE THE NEED FOR BULKY HIGH-POWER, HIGH-VOLTAGE SELECTOR SWITCHES AND RELATED CONTROL CIRCUITS. A CONCEPTUAL DESIGN WILL BE DEVELOPED AFTER STUDYING PREVIOUS ARCJET TESTING AND SURVEYING AVAILABLE FUSES AND CHEMICALLY ACTIVATED FUSIBLE LINKS. AN INTEGRATED CONTROL SYSTEM DESIGN WILL INTERCONNECT MULTIPLE THRUSTERS TO A SINGLE ARCJET PCU, CAPABLE OF HIGH CURRENT (300 A) AND HIGH BLOCKING VOLTAGE (1000-2000 V). HIGH POWER ARCJET THRUSTERS HAVE APPLICATION TO THE SP-100 MISSION AS WELL AS TO HIGH POWER ELECTRIC PROPULSION PROPOSED FOR UPCOMING SPACE PROGRAMS.

APPLIED SCIENCES, INC.  
800 LIVERMORE STREET, P.O. BOX 186  
YELLOW SPRINGS, OH 45387  
Program Manager: MR. HICKOK  
Contract #:  
Title: GRAPHITIC CARBON FOAM PREFORMS FOR NET SHAPE 3-D COMPOSITES  
Topic #: SDIO90-007                      Office:                      ID #: 60000

INDIUM PHOSPHATE (INP) MAKES A GOOD PHOTOVOLTAIC MATERIALS THAT CAN WITHSTAND THE LARGE AMOUNT OF RADIATION IN SPACE. HOWEVER, THE SMALL SIZE, LIMITED AVAILABILITY, AND HIGH DENSITY OF INP SUBSTRATES PUSHED THE COST (\$/WATT) AND WEIGHT (WATT/KG) OF INP SOLAR CELLS BEYOND THE BUDGET OF MOST SPACECRAFT. ASTROPOWER WILL DEVELOP AN INP SOLAR CELL BY GROWING THIN-FILM INP ON SILICON SUBSTRATES. THE MATERIAL CAN RESIST RADIATION BETTER THAN SILICON ALONE, AND CAN CONVERT MORE LIGHT INTO ELECTRICITY -- WITH AN EFFICIENCY OF 20% COMPARED TO 13-14% FOR SILICON. THE NEW DEVICE ALSO WEIGHS MUCH LESS THAN PURE INP. FURTHER, IT COSTS LESS, AND IT CAN ENDURE HIGHER TEMPERATURES -- UP TO 600 C (1110 F). A 4 CM BY 4 CM DEVICE CAN PRODUCE 674 W/KG. AN INP SOLAR CELL COULD REPLACE SILICON AND GAAS TO GENERATE POWER FOR SPACECRAFT. INP'S HIGHER EFFICIENCY MAY EVEN ALLOW IT TO POWER SOME SPACECRAFT, WHICH PREVIOUSLY COULD ONLY RUN ON NUCLEAR POWER. THIN-FILM INP ON SILICON

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COULD INCREASE THE USE OF SOLAR CELLS ON EARTH, INCLUDING APPLICATIONS IN CALCULATORS, APPLIANCES, AUTOMOBILES, AND TO PROVIDE POWER FOR HOMES. IT COULD PRODUCE ELECTRICITY FOR REMOTE REFRIGERATORS IN THIRD WORLD COUNTRIES, AND POWER COMMUNICATION EQUIPMENT IN THE DESERT.

FOSTER-MILLER INC

350 SECOND AVE

WALTHAM, MA 02254

Program Manager: DAVID H WALKER

Contract #:

Title: THERMAL RADIATION INSULATION FOR LONG-TERM CRYOGENIC STORAGE

Topic #: SDIO90-007

Office:

ID #: 40779

A NOVEL TECHNIQUE FOR CRYOGENIC STORAGE IS BEING DEVELOPED IN WHICH THE INNER AND OUTER VESSELS OF A CRYOGENIC DEWAR ARE SEPARATED NOT BY A VACUUM BUT BY MAGNETICALLY SUSPENDED MICROSPHERES. IT IS NOVEL IN THAT THE SUSPENSION OF THE METALLIC MICROSPHERES REQUIRES CRYOGENIC COOLING SUPPLIED FROM THE CRYOGENIC COOLANT BEING INSULATED. SUPERIOR THERMAL INSULATION IS ACHIEVED BECAUSE MINIMAL INTERPARTICLE CONTACT AND AN INFRARED REFLECTIVELY APPROACHING UNITY. THE TECHNIQUE EMPLOYS THE MEISSNER EFFECT IN HIGH TEMPERATURE SUPERCONDUCTING PARTICLES TO OBTAIN A DYNAMICALLY STABLE SUSPENSION. A TEST SYSTEM WILL BE CONSTRUCTED TO OBSERVE MAGNETIC SUSPENSION, EVALUATE HEAT LOAD CHARACTERISTICS, AND ULTIMATELY LEAD TO THE DESIGN OF A SMALL-SCALE PROTOTYPE. THE INSULATING TECHNIQUE IS APPLICABLE TO EARTH-BASED CRYOGENIC INSULATION AS WELL AS FOR LOW GRAVITY APPLICATIONS. THE PRINCIPLES OF THE INNOVATION CAN ALSO BE APPLIED TO NOVEL THERMAL SWITCHES.

ISOTHERMAL SYSTEMS RESEARCH INC

PO BOX 185

LEXINGTON, KY 40584

Program Manager: DR MARTIN R PAIS

Contract #:

Title: PERMEABILITY OF HYDROGEN IN SILICON

Topic #: SDIO90-007

Office:

ID #: 40774

INSTEAD OF USING A SECONDARY FLUID, SUCH AS WATER, TO COOL SILICON ELECTRONIC CIRCUITS, THIS PROJECT WILL USE LIQUID HYDROGEN TO COOL THE CIRCUITS DIRECTLY. THIS ELIMINATES THE NEED FOR A HEAT EXCHANGER, PUMPS, RADIATORS, AND THEIR SUPPORT STRUCTURES, THEREBY REDUCING WEIGHT AND COST. LIQUID HYDROGEN ALSO COOLS THE CIRCUITS TO A MUCH LOWER TEMPERATURE, 173 K (-150 F), WHICH ALLOWS THE CIRCUITS TO OPERATE MORE EFFICIENTLY AND RELIABLY. IN THIS PROJECT, LIQUID HYDROGEN FLOWS THROUGH MICROCHANNELS IN THE SILICON ELECTRONICS, JUST LIKE WATER FLOWS THROUGH A RIVER BED. THE HYDROGEN COOLS THE SILICON ON THE BOTTOM AND SIDES OF THE CHANNEL. HOWEVER, HYDROGEN CANNOT BE USED TO COOL THE ELECTRONICS IF IT SIGNIFICANTLY PERMEATES SILICON. THE PERMEATION RATE INCREASES EXPONENTIALLY AS TEMPERATURE INCREASES, SO THE PERMEATION RATE AS CRYOGENIC TEMPERATURES SHOULD BE INFINITESIMAL. TO CHECK THE ACTUAL PERMEATION, THIS PROJECT WILL BUILD AN APPARATUS TO MEASURE HYDROGEN PERMEATION INTO SILICON OVER A WIDE RANGE OF PRESSURES AND TEMPERATURES. THE APPARATUS CAN LATER BE USED TO TEST OTHER MATERIALS. IF THE HYDROGEN PERMEATION IS SMALL, HYDROGEN CAN COOL HIGH-POWER-DENSITY ELECTRONIC CIRCUITS, RADIO-FREQUENCY AMPLIFIERS, KYSTRONS, AND OTHER RADIO-FREQUENCY DEVICES.

SAT-CON TECHNOLOGY CORP

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12 EMILY ST  
CAMBRIDGE, MA 02139

Program Manager: R L HOCKNEY

Contract #:

Title: MAGNETIC BEARINGS AND ELECTRICAL DRIVE SYSTEM FOR CENTRIFUGAL FREON COMPRESSORS

Topic #: SDIO90-007

Office:

ID #: 40776

CURRENTLY, THE BEARINGS AND THE ELECTRICAL DRIVE SYSTEM ARE THE KEY COMPONENTS THAT LIMIT THE PERFORMANCE OF CENTRIFUGAL FREON COMPRESSORS. FREON COMPRESSORS CAN BE EMPLOYED AS HEAT PUMPS IN SPACECRAFT TO SIGNIFICANTLY REDUCE MASS AND RADIATOR AREA, WHILE PERMITTING BETTER THERMAL CONTROL. COMPARED TO CONVENTIONAL MAGNETIC BEARINGS, THIS PROJECT WILL SIMPLIFY THE MECHANICAL DESIGN, AND REDUCE THE SIZE OF THE ELECTRONICS. THE NEW MAGNETIC BEARINGS AND BRUSHLESS ELECTRICAL DRIVES WILL HELP CENTRIFUGAL FREON COMPRESSORS TO LAST LONGER - EXCEEDING A TEN YEAR LIFE. IN ADDITION, THE DESIGN IMPROVES EFFICIENCY, INCREASES SPEED, AND WIDENS THE OPERATING TEMPERATURE. THE BEARINGS CAN ALSO WITHSTAND A LARGER AMOUNT OF MECHANICAL SHOCK. AND SINCE THE DESIGN CONTAINS LESS MOVING PARTS, IT RAISES RELIABILITY, DECREASES VIBRATION, AND CUTS DRAG. THE TECHNOLOGY CAN BE APPLIED TO A WIDE RANGE OF MACHINERY FOR USE IN SPACECRAFT, INCLUDING HEAT ENGINES, GENERATORS, MOTORS, SPEED REDUCERS, AND PUMPS. ON EARTH, THE BEARINGS AND ELECTRICAL DRIVES CAN HELP POWER HIGH SPEED MACHINERY, TURBINES, COMPRESSORS, CENTRIFUGES, PRECISION MACHINING AND PRINTING EQUIPMENT, MARINE DRIVE SHAFTS, AND SCIENTIFIC EQUIPMENT.

THERMACORE INC

780 EDEN RD

LANCASTER, PA 17601

Program Manager: JOHN H ROSENFELD

Contract #:

Title: SIXTY KILOWATT ELECTRON TUBE COOLER

Topic #: SDIO90-007

Office:

ID #: 40773

THIS PROJECT WILL DESIGN A HEAT TRANSFER PIPE TO COOL THE COLLECTOR OF A TRANSMITTING TUBE ON BOARD A SPACECRAFT. THE COLLECTOR MUST DISSIPATE A LARGE AMOUNT OF POWER: 20KW, WITH A PEAK POWER DENSITY OF 360W/CM SQ. TWO ULTIMATE HEAT SINKS ARE AVAILABLE: FLOWING SUPERCRITICAL HYDROGEN (PARAHYDROGEN) AND RADIATION TO DEEP SPACE. WATER COOLED SYSTEMS ARE UNACCEPTABLE BECAUSE THEY REQUIRE EXCESSIVE MASS, POWER, AND MAINTENANCE. WATER IS ALSO UNFAVORABLE BECAUSE IT EXPANDS AS IT FREEZES, WHICH CAN BURST OR DAMAGE A HEAT EXCHANGER. RADIATION COOLING IS LESS FAVORABLE THAN HYDROGEN BECAUSE THE COLLECTOR DOES NOT HAVE A CLEAR VIEW OF DEEP SPACE, AND BECAUSE THE COLLECTOR SIZE WOULD HAVE TO BE INCREASED TO RADIATE 20 KW AT AN ACCEPTABLE COLLECTOR TEMPERATURE (UNDER 350C). HYDROGEN IS AN EXCELLENT COOLANT, BUT IT CAN PERMEATE AND SUBSEQUENTLY DAMAGE THE WALLS OF A VACUUM DEVICE. DETAILED DESIGN TRADE STUDIES WERE PERFORMED IN PHASE I TO EVALUATE INNOVATIVE HEAT EXCHANGER DESIGNS SUCH AS HEAT PIPES. ALTHOUGH A HEAT PIPE DESIGN WILL MEET THE TUBE COOLING REQUIREMENTS, IT WOULD INCREASE FABRICATION COSTS AND WEIGHT. DURING PHASE I, AN INNOVATIVE ALTERNATIVE WAS GENERATED. IT CONSISTS OF A COPPER COLLECTOR TUBE SURROUNDED BY BRAZEN-ON WRAPS OF HYDROGEN TUBING THAT ARE ATTACHED TO THE COLLECTOR'S EXTERIOR SURFACE BY A LAYER OF BRAZED POROUS COPPER POWDER. THE POROUS LAYER VENTS PERMEATING HYDROGEN TO SPACE WHILE ALLOWING HEAT TO CONDUCT THROUGH TO THE HYDROGEN TUBES. BECAUSE THE COLLECTOR WASTE HEAT IS CAPTURED ENTIRELY WITHIN THE COLLECTOR WALL, HEAT WILL BE STOPPED FROM RADIATING TO SENSITIVE AREAS OF THE SPACECRAFT. SEVERAL COMMERCIAL APPLICATIONS INCLUDE HYDROGEN ISOTOPE SEPARATION SYSTEMS, AND AS A HYDROGEN WORKING FLUID RETENTION SCHEME FOR HIGH-PERFORMANCE STIRLING HEAT ENGINES SUCH AS AUTOMOBILE ENGINES AND ELECTRIC POWER GENERATORS. OTHER AEROSPACE APPLICATIONS ARE IN SPACE-BASED RADAR AND ABOARD THE SPACE STATION, AND HYDROGEN HEAT EXCHANGERS FOR HEAT

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PIPES AND OTHER NIOBIUM STRUCTURES FOR NASP. THE TECHNOLOGY MAY ALSO BE USEFUL IN COOLING THE THROATS OF LONG-BURNING ROCKET ENGINES.

MICROCIRC ASSOCS  
102 SCHOLZ PLAZA - #238  
NEWPORT BEACH, CA 92663  
Program Manager: DR T P HARASZTI  
Contract #:  
Title: FAULT-TOLERANT INTELLIGENT STATIC RANDOM ACCESS MEMORY  
Topic #: SDIO90-008                      Office:                      ID #: 40816

THIS PROJECT WILL DEVELOP STATIC RANDOM ACCESS MEMORIES (SCRAMS) THAT ARE INTELLIGENT AND TOLERANT OF FAULTS. THESE INTELLIGENT CIRCUITS WILL CORRECT BOTH HARD AND SOFT TYPES OF ERRORS. CIRCUIT ELEMENTS WITH HARD ERRORS WILL BE REPLACED BY REDUNDANT ELEMENTS, WHILE SOFT ERRORS WILL BE CORRECTED BY ERROR CHECKING AND CORRECTING CIRCUITS. THE CIRCUIT CAN ALSO DO BOOKKEEPING FOR FAULTY AND OCCUPIED LOCATIONS. IT CAN SELF-TEST, SELF-REPAIR, AND HAS SECURITY KEYED ACCESS TO INHIBIT UNAUTHORIZED USE. THE CIRCUIT IS LASER PROGRAMMED TO OPTIMIZE YIELD. THE SRAMS CAN WITHSTAND NUCLEAR RADIATION AND THE IMPACT OF COSMIC PARTICLES. THE CIRCUITS ARE PACKED TO HIGH DENSITY, OPERATE AT HIGH SPEED, AND ARE RELIABLE. THEY DISSIPATE VERY LITTLE POWER AND CAN BE MANUFACTURED AT LOW COST. THE DESIGN IS MAINTENANCE-FREE WITH A LONG LIFETIME, SUITABLE FOR SPACE OR AIRCRAFT CONDITIONS, SUCH AS IN ROBOTS, TELEOPERATORS, AND CONTROLS IN NUCLEAR PLANTS. IT CAN BE MANUFACTURED INTO ULTRA-HIGH AND INTEGRATED CIRCUITS. THE DESIGN COULD INCREASE THE STORAGE CAPACITY, WHILE REDUCING THE SIZE AND WEIGHT OF COMPUTERS, PROCESSORS, AND OTHER ELECTRONIC EQUIPMENT.

APPLIED RESEARCH & ENGINEERING INC  
3 PRESTON CT - STE F  
BEDFORD, MA 01730  
Program Manager: JAMES M ORTOLF  
Contract #:  
Title: INNOVATIVE RESEARCH TESTBED  
Topic #: SDIO90-010                      Office:                      ID #: 40737

SMALL RESEARCH PROJECTS NEED TO TEST AND COMPARE THEIR RESULTS TO A REALISTIC AND COMPLEX SITUATION. THIS PROJECT WILL DEVELOP A TESTBED THAT WILL EFFECTIVELY SIMULATE REAL SITUATIONS. THE TESTBED CONSISTS OF A SET OF ALGORITHMS, WHICH CAN TAKE A FEW OBSERVATIONS AND PREDICT FUTURE POSITIONS OF THE TARGET. THE STUDY WILL DEVELOP AND ANALYZE MODELS OF IR SENSORS, THE BACKGROUND, AND CLUTTER. THE PROJECT WILL CREATE THE MODELS WITH A PARALLEL PROCESSOR. HENCE, THE PROJECT WILL ADVANCE PARALLEL PROCESSING STATE-OF-THE-ART. IT WILL ALSO IMPROVE IR TRACKING OF TARGETS. THE PROJECT WILL ENHANCE SIMULATION, ASSESSING LOW SIGNAL-TO-NOISE EFFECTS, RANGE EFFECTS, AND TARGET SIGNATURES. THE SIMULATION WILL LOOK AT DIFFERENT BACKGROUNDS, TAKING INTO ACCOUNT CORRELATED NOISE, MODULATION OF THE SIGNAL, AND FALSE SIGNALS. IT WILL ALSO EXAMINE SENSORS, OPTICAL EFFECTS, DISTORTIONS OF INFORMATION, AND CORRELATED NOISE SUPERIMPOSED ON DETECTED SIGNALS. THE TESTBED CAN AID OTHER GOVERNMENT PROGRAMS, INCLUDING THE AIR DEFENSE INITIATIVE (ADI) AND ANTI-SATELLITE WEAPONS (ASAT).

CONCEPTUAL SOFTWARE SYSTEMS INC  
17962 SUN KNOLL DR  
YORBA LINDA, CA 92686  
Program Manager: THOMAS H BLEAKNEY

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Contract #:

Title: POLY-COMPILER FOR PARALLEL PROCESSING

Topic #: SDIO90-010

Office:

ID #: 40740

THIS POLY-COMPILER VERY-HIGH-LEVEL PROBLEM SPECIFICATION, AND COMPILES IT FOR A PARALLEL PROCESSING COMPUTER. UNLIKE OTHER COMPILERS FOR PARALLEL COMPUTERS, THIS NEW POLY-COMPILER IS ADAPTABLE AND PORTABLE TO MACHINES WITH DIFFERING ARCHITECTURES. IT CAN ACCOMMODATE BOTH LOOSELY-COUPLED ARCHITECTURE MACHINES-A NETWORK OF PROCESSORS, EACH WITH THIER OWN MEMORY, THAT COMMUNICATE VIA MESSAGES-AND TIGHTLY-COUPLED ARCHITECTURE MACHINES-A NETWORK OF PROCESSORS THAT SHARE THE SAME MEMORY AND COMMUNICATION CIRCUIT. THE POLY-COMPILER MAPS A PARTICULAR PROBLEM ONTO THE MULTIPLE PROCESSORS OF A TARGET MACHINE. THE POLY-COMPILER WILL BE DESIGNED TO HANDLE MANY DIFFERENT TARGET MACHINES, EACH WITH A DIFFERENT ARCHITECTURE OF MULTIPLE PROCESSORS. THE POLY-COMPILER WILL CONTAIN A DATABASE WITH A PROFILE OF EACH OF THE TARGET MACHINES. WITH THIS TOOL, ONE CAN WRITE VERY-HIGH-LEVEL PARALLEL PROBLEM SPECIFICATION, AND THE PROBLEM WILL BE AUTOMATICALLY RESTRUCTURED FOR ANY PARALLEL COMPUTER SYSTEM IN THE POLY-COMPILERS DATABASE. THIS SAVES THE HIGHG COST OF MANUALLY REPROGRAMMING A PROBLEM FOR EACH TARGET PARALLEL COMPUTER. IT ALSO MAKES IT ECONOMICAL TO TEST COMPLEX PROBLEMS ON SEVERAL DIFFERENT PARALLEL COMPUTER SYSTEMS. THE POLY-COMPILER IS DESIGNED FOR COMPUTERS WITH PARALLEL PROCESSORS FOR MILITARY OR COMMERCIAL USE.

IMEC

1214 OXFORD ST

BERKELEY, CA 94709

Program Manager: DR RICHARD SPITZER

Contract #:

Title: DATA TRANSFER FOR MAGNETIC STORAGE INFORMATION WITHOUT MACROSCOPIC MOTION

Topic #: SDIO90-010

Office:

ID #: 40738

A DEVICE HAS BEEN DESIGNED AND WILL BE FABRICATED, WITHOUT MACROSCOPIC MOVING PARTS FOR TRANSFERING DATA FROM THE COMPUTER TO STORAGE, AND BACK. NORMALLY, THE CENTRAL PROCESSING UNIT (CPU) PROCESSES DATA ORDERS OF MAGNITUDE FASTER THAN THE TIME SPENT FOR MECHANICAL MOVEMENT IN ORDINARY DISC DRIVES. DISC DRIVES ARE INPUT/OUTPUT (I/O) DEVICES. IN MANY APPLICATIONS I/O, NOT PROCESSING TIME, IS THE FACTOR THAT LIMITS THROUGHPUT. THE NEW DEVICE REPLACES THE DISC DRIVE, AND CAN REDUCE I/O TIME BY NEARLY 4 ORDERS OF MAGNITUDE. IT ALSO IMPROVES RELIABILITY IN DATA PROCESSING, BECAUSE IT ELIMINATES MECHANICAL MOTION FROM THE I/O OPERATION. SINCE THE DEVICE INCREASES THE I/O SPEED TO NEARLY THAT OF THE CPU, IT CAN ELIMINATE THE NEED FOR I/O BUFFERS FOR CERTAIN APPLICATIONS. FURTHER, THE DEVICE RESISTS SHOCK AND VIBRATION BETTER THAN STANDARD DISC DRIVES. THE DEVICE COULD REPLACE DISC DRIVES IN A WIDE RANGE OF MILITARY AND COMMERCIAL COMPUTERS.

ODYSSEY RESEARCH ASSOCS INC

301A HARRIS B DATES DR

ITHACA, NY 14850

Program Manager: IAN SUTHERLAND

Contract #:

Title: SECURE NETWORK DEVICE DRIVER

Topic #: SDIO90-010

Office:

ID #: 40741

THE PROJECT WILL DESIGN AND IMPLEMENT A PROTOTYPE SECURE ETHERNET DEVICE DRIVER IN PROGRAMMING LANGUAGE C. THE DRIVER WILL ENFORCE MULTILEVEL SECURITY FOR A LOCAL AREA NETWORK. THE PROJECT WILL ALSO DEFINE A MATHEMATICAL MODEL OF SECURITY FOR THE DRIVER. A FORMALLY VERIFIED DEVICE DRIVER CAN PROVIDE LOW COST NETWORK SECURITY FOR MILITARY,



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GOVERNMENT, AND COMMERCIAL NETWORKS.

PARA-SOFT CORP  
2500 E FOOTHILL BLVD - STE 205  
PASADENA, CA 91107  
Program Manager: DR JON FLOWER  
Contract #:  
Title: AUTOMATIC PARALLELIZATION TOOL FOR SEQUENTIAL PROGRAMS  
Topic #: SDIO90-010                      Office:                      ID #: 40739

THIS PROJECT WILL IMPROVE A SYSTEM THAT AUTOMATICALLY CONVERTS SEQUENTIAL COMPUTER PROGRAMS INTO PARALLEL PROGRAMS. THE SYSTEM IS FOR PARALLEL COMPUTERS WITH DISTRIBUTED MEMORY, WHERE THE MEMORY IS DISTRIBUTED OVER SEVERAL DIFFERENT LOCATIONS. WHEREVER POSSIBLE, THE DEVICE INSERTS SUITABLE PARALLEL PROGRAMMING CONSTRUCTS INTO SEQUENTIAL CODE, ALLOWING THE SYSTEM TO EXECUTE, IN PARALLEL, ON A WIDE VARIETY OF PARALLEL COMPUTERS. IF THE DEVICE CANNOT DECOMPOSE THE TARGET PROGRAM, IT WILL INDICATE GRAPHICALLY TO THE PROGRAMMER THAT HUMAN INTERVENTION IS NEEDED. THE DEVICE COULD ELIMINATE BOTTLENECKS IN PARALLEL PROCESSING SOFTWARE. THE GOAL OF PARALLEL PROCESSING IS TO INCREASE SPEED, WITH THE GREATER THE NUMBER OF PROCESSORS, THE FASTER THE ABILITY TO SOLVE PROBLEMS. THIS DEVICE ALLOWS SOFTWARE DEVELOPED FOR SERIAL COMPUTERS TO BE EXECUTED ON PARALLEL COMPUTERS. THE CURRENT SYSTEM IS TARGETED FOR C PROGRAMS. HOWEVER, THE TECHNIQUE FOR ANALYZING AND PARALLELIZING THE CODES WOULD APPLY TO ANY LANGUAGE. THE DEVICE CAN EITHER AUTOMATE OR ASSIST USERS IN PORTING OR DESIGNING NEW CODES. THIS TOOL WILL ENCOURAGE AND INFLUENCE THE DESIGN OF FUTURE DISTRIBUTED MEMORIES AND PARALLEL COMPUTERS.

PARA-SOFT CORP  
2500 E FOOTHILL BLVD - STE 205  
PASADENA, CA 91107  
Program Manager: DR ADAM KOLAWA  
Contract #:  
Title: HETEROGENEOUS PARALLEL PROCESSING CAPABILITY  
Topic #: SDIO90-010                      Office:                      ID #: 40807

THIS PROJECT WILL DEVELOP A HETEROGENEOUS PARALLEL PROCESSING SYSTEM. THE SYSTEM CAN COMBINE THE ABILITIES OF MANY DIFFERENT COMPUTER SYSTEMS BY PROVIDING A UNIFORM PROGRAMMING MODEL AND DEVELOPMENT SYSTEM THAT EXECUTES PROGRAMS, IN PARALLEL, ON MANY DIFFERENT TYPES OF COMPUTERS SIMULTANEOUSLY. FOR EXAMPLE, THIS ALLOWS ONE TO DEVELOP A SUPERCOMPUTING SYSTEM THAT COMBINES THE EFFORTS OF THE CONNECTION MACHINE, THE CRAY, NCUBE, AND IBM TECHNOLOGY TO ATTACK IMPORTANT PROBLEMS, WHICH OTHERWISE COULD BE SOLVED SUBOPTIMALLY ON EACH INDIVIDUAL MACHINE. THE PARALLEL PROCESSOR COULD SERVE IN MODELING THE WEATHER, SOLVING COMPLEX PROBLEMS IN FLUID DYNAMICS, AND CREATING BETTER MEDICAL IMAGES.

SILICON ENGINES INC  
955 COMMERCIAL ST  
PALO ALTO, CA 94303  
Program Manager: TED E WILLIAMS  
Contract #:  
Title: ROBUST ITERATIVE LOW-LATENCY SELF-TIMED CIRCUITS  
Topic #: SDIO90-010                      Office:                      ID #: 40772

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THIS PROJECT WILL DEVELOP A METHOD FOR DESIGNING ELECTRONIC CIRCUITS, WHICH CAN CALCULATE 2 TO 3 TIMES FASTER THAN CONVENTIONAL CIRCUITS. IN A CONVENTIONAL CIRCUIT, THE DATA MUST GO THROUGH LATCHES TO SYNCHRONIZE IT. CONVENTIONAL CIRCUITS TAKE LONGER BECAUSE THE LATCHES REQUIRE SET-UP AND PROPAGATION TIME. A GLOBAL CLOCK IS SPREAD OVER THE ENTIRE CHIP. MISMATCH OF DELAYS IN DIFFERENT SECTIONS, MARGINS OF ERROR FOR THE GLOBAL CLOCK, AND DERATING FOR THE WORST CASE CONDITIONS ALL SLOW DOWN THE CIRCUIT. THE NEW SYSTEM HAS NO LATCHES, SO IT SAVES TIME—BECAUSE DATA DOESN'T HAVE TO GO THROUGH THE LATCHES. IT IS ALSO SELF-TIMED, ELIMINATING GLOBAL OR EXTERNAL CLOCKS AND THE PROBLEMS ASSOCIATED WITH THEM. A CONVENTIONAL CIRCUIT IS SYNCHRONOUS; EVERYTHING IS IN THE SAME FREQUENCY. IN A SELF-TIMED CIRCUIT, EVERYTHING HAPPENS AS SOON AS IT CAN, RATHER THAN WAITING FOR THE NEXT CLOCK TICK. THE SYSTEM ALSO INCORPORATES SOME PARALLEL PROCESSING, WHICH OVERLAPS THE STEPS. THE NEW TECHNIQUE CAN FUNCTION IN A WIDER RANGE OF CONDITIONS, INCLUDING CHANGES IN POWER SUPPLY, VOLTAGE, AND TEMPERATURE. FURTHER, SINCE IT DOESN'T NEED LATCHES OR CLOCKS, IT REQUIRES A MUCH SMALLER AREA OF A SILICON CHIP THAN CONVENTIONAL CIRCUITS. THE METHOD HAS APPLICATION IN A WIDE RANGE OF MILITARY AND COMMERCIAL COMPUTERS. IT CAN PERFORM HIGH-SPEED ARITHMETIC, ESPECIALLY DIVISION, SQUARE ROOT, AND TRANSCENDENTAL FUNCTIONS, SUCH AS IRRATIONAL NUMBERS. IT CAN CONVERT POLAR TO RECTANGULAR COORDINATES, AND BE USED IN VECTOR PROCESSING, AND DIGITAL SIGNAL PROCESSING.

APA OPTICS INC  
2950 NE 84TH LN  
BLAINE, MN 55434  
Program Manager: DR M ASIF KHAN  
Contract #:  
Title: HIGH SPEED TRAVELING WAVE MODULATORS  
Topic #: SDIO90-011                      Office:                      ID #: 40748

THIS PROJECT WILL DEVELOP TECHNOLOGY THAT CONVERTS ELECTRICAL SIGNALS TO OPTICAL SIGNALS. THE DEVICE CONSISTS OF A GAAS LIGHT MODULATOR WITH SUPERCONDUCTING ELECTRODES. THE MODULATOR FIRST SPLITS THE LIGHT INTO TWO WAVES. THEN BY ADJUSTING THE TEMPERATURE, ONE CAN ALTER THE IMPEDANCE IN THE ELECTRODES—UNTIL ONE MATCHES THE PHASE VELOCITY OF THE MICROWAVE WITH THE OPTICAL WAVE. THIS MATCHING ALLOWS ONE TO CONVERT THE ELECTRICAL SIGNALS TO OPTICAL SIGNALS. THIS MODULATOR CAN BE USED FOR HIGH-FREQUENCY KA BAND (GREATER THAN 20 GHZ) SATELLITE COMMUNICATIONS AND PHASED ARRAY RADARS. ON COMMERCIAL OR MILITARY SATELLITES, THE DEVICE CAN FIRST CONVERT ELECTRICAL TO OPTICAL SIGNALS, AND THEN TRANSMIT THE SIGNALS TO MONOLITHIC MICROWAVE INTEGRATED CIRCUITS (MMICS) ON RADARS AND OTHER DEVICES. THE TECHNOLOGY ALLOWS SMALL OPTICAL FIBER CABLES TO REPLACE LARGE COAXIAL CABLES NOW USED TO SEND ELECTRICAL SIGNALS. THE DEVICE CAN ALSO BE APPLIED IN FIBER-OPTICS DATA COMMUNICATION SYSTEMS.

FOSTER-MILLER INC  
350 SECOND AVE  
WALTHAM, MA 02254  
Program Manager: DR LAWRENCE H DOMASH  
Contract #:  
Title: SPATIAL LIGHT MODULATOR WITH OPTICAL GAIN  
Topic #: SDIO90-011                      Office:                      ID #: 40747

OPTICALLY ADDRESSED SPATIAL LIGHT MODULATORS (SLM) WITH FAST RESPONSE TIME AND LOW OPERATING POWER PLAY A KEY ROLE IN OPTICAL COMPUTING, PATTERN RECOGNITION, AND NEURAL NETWORK ARCHITECTURES. PRESENTLY AVAILABLE DEVICES HAVE A FIXED RATIO BETWEEN INPUT AND OUTPUT LIGHT INTENSITY. TO ADDRESS THESE CONCERNS, A NEW SLM WILL BE DESIGNED AND BUILT USING A RECENTLY DISCOVERED LARGE GAIN, TWO-BEAM COUPLING BASED ON THE FRANZ-KELDYSH

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EFFECT IN INGAAS OR INP:FE AT NEAR-IR WAVELENGTHS. THE DEVICE HAS A VERY FAST FRAME RATE ON THE ORDER OF 100 KHZ AND THE POTENTIAL FOR THE OPTICAL INCOHERENT TO COHERENT CONVERSION COEFFICIENT TO BE ELECTRICALLY ADDRESSED OVER A WIDE RANGE. THE DEVICE APPEARS CAPABLE OF LOW-COST VOLUME MANUFACTURE AND MAY ENABLE PROGRESS IN A WIDE RANGE OF DESIRED MILITARY AND CIVILIAN LASER-BASED COMPUTING SYSTEMS.

FOSTER-MILLER INC  
350 SECOND AVE  
WALTHAM, MA 02254  
Program Manager: DR LAWRENCE H DOMASH  
Contract #:  
Title: OPTICAL COMPUTER FOR FRACTAL IMAGE ANALYSIS  
Topic #: SDIO90-011                      Office:                      ID #: 40769

FRACTAL PATTERNS FROM BOTH NATURAL AND MANMADE SOURCES ARE CRITICAL TO INTERPRETING MANY MILITARY IMAGES. THIS PROJECT WILL PRODUCE AN OPTICAL COMPUTER TO ANALYZE FRACTAL PATTERNS. PHASE I WILL DESIGN, TEST, AND ANALYZE A HIGH-SPEED COMPUTER THAT WILL IDENTIFY FRACTAL PATTERNS WITHIN IMAGES AND MEASURE THEIR FRACTAL DIMENSIONS. THIS EFFORT WILL BUILD AN AUTOMATIC OPTICAL COMPUTER THAT IS NONLINEAR AND CELLULAR IN DESIGN. PHASE II WILL DEVISE A COMPLETE ITERATIVE SYSTEM THAT ANALYZES FRACTALS USING PHOTOREFLECTIVE CRYSTALS. THE SYSTEM COULD LABEL CERTAIN IMAGES AS "CLOUD", "MOUNTAINS", OR "SEA", REQUIRING ONLY A FEW MICROSECONDS TO COMPUTE. FURTHER, SIMPLE ALL-OPTICAL COMPUTERS MAY BE ABLE TO MATHEMATICALLY MANIPULATE FRACTALS. THIS FRACTAL ANALYZING OPTICAL COMPUTER COULD CONTRIBUTE TO A WIDE RANGE OF TACTICAL AND STRATEGIC MILITARY MISSIONS. IT MIGHT SERVE IN REMOTE SENSING OR MACHINE VISION. IT COULD ALSO INTERPRET IMAGES FROM SATELLITES, MICROSCOPES, AND MEDICAL SCANNERS.

LASER PHOTONICS TECHNOLOGY INC  
1576 SWEET HOME RD  
AMHERST, NY 14221  
Program Manager: DR RYSZARD BURZYNSKI  
Contract #:  
Title: SECOND HARMONIC GENERATOR FOR PHOTONICS USING MULTIFUNCTIONAL NONLINEAR WAVEGUIDES  
Topic #: SDIO90-011                      Office:                      ID #: 40796

THIS PROGRAM WILL FABRICATE SECOND HARMONIC GENERATORS USING SOL/GEL PROCESSING. IN SOL/GEL PROCESSING, CHEMICALS AND DOPANTS ARE MIXED WITH WATER AND A CATALYST. THIS FORMS A SOL, OR SOLUTION. THE CATALYST CAUSES THE SOLUTION TO GEL. THE GEL IS THEN HEATED TO FORM OXIDE GLASSES. THE PROCESS ALLOWS ONE TO ADD ANY KIND OF DOPANT DESIRED TO PRODUCE GLASSES WITH SPECIAL PROPERTIES. BY VARYING THE DOPANTS, THE GLASSES CAN BE MADE INTO SEVERAL DIFFERENT FORMS, SUCH AS A THIN FILM, OR A FIBER. IN THIS CASE, THE DOPED GLASSES WILL BE MADE INTO PLANAR GLASS WAVEGUIDES, WHICH IN TURN ARE MADE INTO SECOND HARMONIC GENERATORS. IN OPERATION, LIGHT COMES INTO THE DEVICE, AND THE SECOND HARMONIC GENERATOR DOUBLES THE FREQUENCY. THE DEVICE IS NON-RESONANT, SO IT WON'T ABSORB PRIMARY RADIATION. IT CAN ALSO COVER A BROAD BAND OF WAVELENGTHS, WITH HIGH OPTICAL QUALITY, AND LARGE THROUGHPUT. THE GLASSES CAN WITHSTAND A LOT OF RADIATION BEFORE BECOMING DAMAGED. THE GENERATOR'S GREATER EFFICIENCY ALLOWS LOW-POWER DIODE LASERS TO BE USED TO STORE HIGH-DENSITY OPTICAL DATA. PLANAR WAVEGUIDES CAN REPLACE OPTICAL FIBERS IN INTEGRATED OPTICAL CHIPS. THE TECHNOLOGY COULD CREATE MINIATURE INTEGRATED CIRCUITS, AND TAILOR-MADE CIRCUITS FOR COMMUNICATIONS.

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PHYSICAL OPTICS CORP  
2545 W 237TH ST - STE B  
TORRANCE, CA 90505

Program Manager: DR RAY T CHEN

Contract #:

Title: OPTICALLY ACTIVATED MODULATOR ON GALLIUM ARSENIDE-GALLIUM ALUMINUM ARSENIDE  
COMPOUND SEMICONDUCTOR CHANNEL WAVEGUIDE

Topic #: SDIO90-011

Office:

ID #: 40813

THIS PROJECT WILL MAKE AN OPTICAL MODULATOR FOR OPTICAL COMPUTING AND SIGNAL PROCESSING. THE DEVICE EMPLOYS TWO WAVELENGTHS OF LIGHT. THE LONGER WAVELENGTH (LW) OPTICAL WAVE CARRIES THE SIGNAL, I.E., IT CONTAINS THE INFORMATION. THE SHORTER WAVELENGTH (SW) OPTICAL WAVE ACTS AS AN ACTIVATING SOURCE, LIKE A SWITCH THAT CONTROLS, OR TURNS ON AND OFF, THE LW WAVE. THE SW WAVE DOES THIS BY GENERATING FREE ELECTRON-HOLE PAIRS. THESE PAIRS MODULATE THE REFRACTIVE INDEX, WHICH CAN BE TWO ORDERS OF MAGNITUDE LARGER THAN CONVENTIONAL ELECTRO-OPTIC MODULATORS. THE DEVICE CAN HANDLE BOTH COHERENT AND INCOHERENT LIGHT. THE INTERACTION LENGTH OF THIS DEVICE IS VERY SMALL (100 MICRONS), WHICH IS 20 TIMES SMALLER THAN CONVENTIONAL ELECTRO-OPTIC DEVICES. VERY SHORT INTERACTION LENGTHS ALLOW THE MODULATOR TO OCCUPY A VERY SMALL SURFACE AREA. ELECTRICAL DEVICES GIVE OFF ELECTRO-MAGNETIC INTERFERENCE (EMI) NOISE--HINDERING COMPUTERS FROM WORKING IN EM RADIATION PROLIFERATED ENVIRONMENT. THIS NEW DEVICE IS PURELY OPTICAL, SO IT GIVES OFF NO EMI NOISE. THE DEVICE ALSO PROVIDES GREATER FREEDOM IN CHOOSING THE WAVELENGTH OF THE SIGNAL CARRIER (FROM 0.9 TO 1.6 MICRONS OR HIGHER). SINCE IT WORKS WITH BOTH COHERENT AND INCOHERENT LIGHT, THE DEVICE IS COMPATIBLE WITH NEARLY ANY COMMUNICATION SYSTEM, INCLUDING LOCAL AREA NETWORKS, HIGH-DEFINITION TELEVISION, LONG-DISTANCE COMMUNICATIONS, AND EVEN SPACE-BASED NETWORKS. IT CAN SERVE IN LASER WARNING SYSTEMS, AND CURRENT OR VOLTAGE SENSORS. IT CAN HELP PERFORM VECTOR MULTIPLICATION IN OPTICAL COMPUTERS, AND PROCESS BOTH OPTICAL AND ELECTRO-OPTICALLY GENERATED SIGNALS.

PHYSICAL OPTICS CORP  
2545 W 237TH ST - STE B  
TORRANCE, CA 90505

Program Manager: DR FREDDIE LIN

Contract #:

Title: HIGH DENSITY RECONFIGURABLE OPTICAL INTERCONNECTS BASED ON A MULTIPLEXED  
HOLOGRAPHIC FABRY-PEROT RESONATOR

Topic #: SDIO90-011

Office:

ID #: 40814

THE PROJECT WILL DESIGN A HIGH DENSITY OPTICAL INTERCONNECT THAT CAN BE RECONFIGURED. THE DEVICE ALLOWS A SINGLE OUTPUT SIGNAL TO BE SENT ALONG DIFFERENT PATHS. THE PROJECT EMPLOYS A SPECIAL MATERIAL THAT MANIPULATES DATA, WHICH IS IN THE FORM OF LIGHT. THE INTERCONNECT CAN GO FROM 1 TO N, CONVERTING ONE INPUT TO GET MANY OUTPUT LIGHTS. IF ONE APPLIES A VOLTAGE, IT CHANGES THE MATERIAL'S INDEX OF REFRACTION, GIVING A DIFFERENT SET OF OUTPUT LIGHTS. IT CAN ALSO GO FROM N TO N, WHERE N INPUTS GET N OUTPUTS. TO DO THIS, THE MATERIAL IS DOPED, AND PUT IN SEVERAL LAYERS, SO IT CAN HANDLE MULTIPLE INPUTS. THE DEVICE CAN RECONFIGURE IN A VERY SHORT TIME -- AS LITTLE AS A FEW NANOSEC. THE OPTICAL INTERCONNECTS WORK FASTER, AND REQUIRE LESS POWER THAN ELECTRICAL DEVICES. THE INTERCONNECT EMPLOYS AN OPTICAL RESONATOR, WHICH SERVES TO FEED BACK THE LIGHT, THEREBY INCREASING EFFICIENCY. IT ALSO CONTAINS A HIGH CAVITY FINESSE -- IE. IT CAN HOLD A LARGE NUMBER OF RECONFIGURABLE CHANNELS. FURTHER, THIS PROJECT WILL STUDY THE ABILITY TO EXPAND THE TECHNOLOGY TO A 2D ELEMENT ARRAY. THE OPTICAL INTERCONNECT CAN BE APPLIED IN OPTICAL COMPUTING AND NEURAL NETWORKS, AS WELL AS OPTICAL COMMUNICATION AND OPTICAL SIGNAL PROCESSING.

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SPARTA INC  
23041 AVENIDA DE LA CARLOTA - STE 400  
LAGUNA HILLS, CA 92653

Program Manager: DR STEVEN A LIS

Contract #:

Title: ULTRA-DENSE OPTICAL STORAGE

Topic #: SDIO90-011

Office:

ID #: 40743

THIS PROJECT WILL USE SPECTRAL HOLE BURNING MATERIALS TO OBTAIN ULTRA-DENSE OPTICAL DATA STORAGE. TO CREATE A SPECTRAL HOLE BURNING MATERIAL, ONE MIXES AN ORGANIC CHEMICAL, SUCH AS PORPHYRIN OR PORPHINE, WITH AN ORGANIC POLYMER, SUCH AS POLYETHYLENE OR POLYSTYRENE, AND THEN LOWERS THE TEMPERATURE TO 4 DEGREES K. AT THAT TEMPERATURE, ONE CAN BLEACH, I.E., MAKE THE MATERIAL TRANSPARENT, AT ONLY A SPECIFIC WAVELENGTH. HENCE, ONE CAN RECORD A PICTURE AT A SPECIFIC WAVELENGTH, AND AT ANOTHER WAVELENGTH, ONE CAN STORE ANOTHER PICTURE. TO GET THE PICTURE OUT, JUST SHINE THAT PARTICULAR WAVELENGTH BACK ON THE MATERIAL, AND ONLY THAT PICTURE WILL COME OUT. THE PICTURES ARE ACTUALLY IN THE FORM OF HOLOGRAMS. WHEN COUPLED WITH THE ADDED DIMENSIONS OF FREQUENCY AND APPLIED ELECTRIC FIELD, ONE CAN STORE AS MUCH AS  $10^{14}$  BITS IN ONE CM<sup>3</sup> OF MATERIAL. THIS IS 1,000 TIMES GREATER THAN OTHER OPTICAL METHODS, AND ONE MILLION TIMES MORE THAN CURRENT ELECTRONIC COMPUTERS. MEMORIES WITH THIS ENORMOUS CAPACITY COULD BE EXTREMELY COMPACT, AND MUCH LIGHTER--WHICH IS ESPECIALLY IMPORTANT IN SPACE-BASED COMPUTERS. THEY CAN ALSO BE USED IN BOTH OPTICAL AND ELECTRONIC GROUND-BASED COMPUTERS. THEY PROVIDE RAPID ACCESS TO ENORMOUS QUANTITIES OF DATA, AND WITH A LOW COST PER BIT OF MEMORY.

DYNAMICS TECHNOLOGY INC  
21311 HAWTHORNE BLVD - STE 300  
TORRANCE, CA 90503

Program Manager: RICHARD CHILES

Contract #:

Title: NEURAL NETWORK CONTROL OF DEFORMATIONS OF LARGE SPACE

Topic #: SDIO90-012

Office:

ID #: 40815

A NEURAL NETWORK CONTROL PROCESSOR IS BEING DEVELOPED AS PART OF A CONTROL SYSTEM TO DAMPEN VIBRATIONS IN LARGE SPACE STRUCTURES. THE NEURAL NETWORK CAN INDEPENDENTLY LEARN THE DYNAMICS OF A SYSTEM WITHOUT OUTSIDE INTERVENTION. THIS IS A SIGNIFICANT ADVANTAGE OVER OTHER CONTROLLER METHODS IN WHICH THE IMPLEMENTATION OF A LARGE NUMBER OF INPUTS AND OUTPUTS IS DIFFICULT. THE NETWORK CONTROLLER WILL BE IMPLEMENTED ON A LABORATORY COMPOSITE STRUCTURE UNDER CURRENT DEVELOPMENT WHICH CONSISTS OF EMBEDDED FIBER-OPTIC STRAIN SENSORS AND EXTERNAL ACTUATORS. A COMPUTER SIMULATION WILL ALSO BE PERFORMED TO DEMONSTRATE THE ROBUSTNESS OF THE PROCESSOR TO LEARN PROPER CONTROL DYNAMICS FOR A VERY LARGE NUMBER OF COMPONENTS. THE NEURAL NETWORK DESIGN CAN BE APPLIED TO A MULTITUDE OF CONTROL SYSTEMS INCLUDING LARGE SCALE SPACE AND OCEAN PLATFORMS, TURBINES, AND AIRCRAFT WINGS.

INTERNATIONAL DYNAMICS CORP  
316 SPRING RUN CIR  
LONGWOOD, FL 32779

Program Manager: JAY LIPELES

Contract #:

Title: CERAMIC FOAM SANDWICH AS A STRUCTURAL MATERIAL

Topic #: SDIO90-012

Office:

ID #: 40783

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THIS PROJECT WILL BRING TOGETHER SEVERAL TECHNOLOGIES TO PRODUCE REINFORCED CERAMIC FOAM SANDWICHES. A SANDWICH PANEL CONSISTS OF A REINFORCED CERAMIC FOAM CORE AND REINFORCED CERAMIC FACE SKINS. TO PRODUCE THESE SANDWICHES, ONE MUST FOAM THE CERAMIC, THEN BOND THE CERAMIC FOAM TO THE SKINS WITHOUT THE USE OF ADHESIVES. VERY SMALL WHISKERS REINFORCE THE FOAM. SPECIAL COATINGS ON THE REINFORCING PARTICLES AND WHISKERS REDUCE BRITTLINESS, A PROBLEM WITH PREVIOUS CERAMICS. THE RESULTING REINFORCED CERAMIC FOAM SANDWICH IS EXTREMELY STRONG, LIGHT, AND STIFF. CERAMICS CAN ALSO WITHSTAND MUCH HIGHER TEMPERATURES THAN EPOXY OR OTHER POLYMER COMPOSITES. THESE CERAMIC FOAM SANDWICHES MAY FIND A WIDE VARIETY OF USES, INCLUDING AIRCRAFT AND SPACE STRUCTURES, OPTICAL DEVICES, SPORTING GOODS, AND ENGINE COMPONENTS.

TECHNO-SCIENCES INC

7833 WALKER DR - STE 620

GREENBELT, MD 20770

Program Manager: DR WILLIAM H BENNETT

Contract #:

Title: NONLINEAR CONTROLS/STRUCTURES INTERACTION WITH ADAPTIVE CONTROLLERS

Topic #: SDIO90-012

Office:

ID #: 40784

IN A SPACE STRUCTURE, ONE NEEDS TO PREVENT THE STRUCTURE FROM FAILING DUE TO VIBRATION OR AN UNBALANCED FORCE. TO CONTROL THE STRUCTURE'S MOTION WHEN IT IS ACTED UPON BY AN EXTERNAL FORCE, ONE MUST KNOW HOW THE STRUCTURE WILL RESPOND, SO ONE CAN COUNTERACT THIS MOTION. RECENTLY DEVELOPED CONTROL LAWS CAN DEFINE A STRUCTURE'S ULTIMATE MOTION. THESE CONTROL LAWS CAN PREDICT THE MOTION AND FORCES OF A MULTI-BODY SYSTEM MADE OF FLEXIBLE BODIES. FLEXIBLE BODIES RESPOND IN MORE COMPLEX MANNER THAN RIGID BODIES. THE CONTROL LAWS CAN SEPARATE THE MOTION OF A FLEXIBLE BODY INTO VIBRATING MOTION AND RIGID BODY MOTION. THIS TRANSFORMS A DIFFICULT-TO-SOLVE NON-LINEAR PROBLEM INTO SEVERAL MORE EASILY SOLVED LINEAR PROBLEMS. THIS PROJECT WILL TEST THE VALIDITY OF THESE CONTROL LAWS. THE SYSTEM EMPLOYS FEEDBACK CONTROL, SO IT CALCULATES WHAT THE MOTION WILL BE, IT FEEDSBACK THAT INFORMATION INTO THE SYSTEM TO COUNTER THE UNBALANCED FORCES. THE SYSTEM AUTOMATICALLY CONTROLS THE ORIENTATION OF THE SPACECRAFT. CONTROL LAWS CAN RESPOND QUICKLY TO CHANGES IN MOTION. THE CONTROL SYSTEM CAN PRECISION POINT AND ALIGN FLEXIBLE STRUCTURES IN SPACE. THE SYSTEM CAN SERVE IN REMOTE SENSING, SURVEILLANCE, WEAPON PLATFORMS, AND LINE-OF-SIGHT NARROW-BEAM COMMUNICATION SYSTEMS.

CORDEC CORP

PO BOX 188 - 8270-B CINDER BED RD

LORTON, VA 22079

Program Manager: DR RAYMOND J WEIMER

Contract #:

Title: HYBRIDIZED METAL MATRIX COMPOSITES FOR PASSIVE DAMPING

Topic #: SDIO90-013

Office:

ID #: 40782

THIS PROJECT WILL DEMONSTRATE A NEW CLASS OF METAL MATRIX COMPOSITES (MMC'S) THAT ARE REINFORCED WITH POLYMERS FOR PASSIVE DAMPING APPLICATIONS. A PASSIVE DAMPING MATERIAL NATURALLY DAMPS ITSELF, WHEREAS ACTIVE DAMPING USES A MECHANICAL DEVICE TO DAMP THE STRUCTURE. THE COMPOSITE EMPLOYS A SPECIAL GRAPHITE/MAGNESIUM MMC WITH A ZERO COEFFICIENT OF THERMAL EXPANSION, AND WHICH DOESN'T CHANGE DIMENSIONS UNDER THERMAL CYCLING OVER THE COMPLETE TEMPERATURE RANGE OF A SPACECRAFT IN ORBIT - FROM -250 TO +250 F. BLENDING A POLYMER INTO GRAPHITE/ MAGNESIUM CREATES A HYBRID MMC. THIS HYBRID IS STRONG, TOUGH, AND RESISTS FATIGUE. IT ALSO IMPROVES DAMPING OVER 50%, AND REDUCES WEIGHT COMPARED TO STANDARD MMC'S. THE HYBRID CONSISTS OF A PREPREG TAPE, ALLOWING ONE TO CUT

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IT, STACK IT, HEAT IT, AND FORM IT JUST LIKE EPOXIES. ONE CAN EVEN BRAID IT OR WEAVE IT. THE HYBRID CAN EASILY BE FABRICATED INTO HEAVY SECTIONS AS WELL AS THIN-GAUGE STRUCTURES, SUCH AS TUBES AND STIFFENERS. THESE HYBRID MMC TUBES COULD LEAD TO BETTER OPTICAL MOUNTS FOR SENSOR ARRAYS, ANTENNAS, TELESCOPES, CAMERAS, AND LASERS. THE IMPROVED DAMPING PERMITS MORE SENSITIVE ANTENNA – A GAIN OF UP TO 60 DECIBELS. THE HYBRID CAN ALSO ACT AS A HEAT SINK FOR SURFACE MOUNTS, SO THEY WON'T CHANGE DIMENSIONS AS THEY HEAT UP.

IONWERKS  
2215 ADDISON  
HOUSTON, TX 77030  
Program Manager: J ALBERT SCHULTZ  
Contract #:  
Title: MONITORING/MODIFYING THIN FILM GROWTH  
Topic #: SDIO90-013                      Office:                      ID #: 40801

BORON NITRIDE (BN) CAN BE USED AS A SOLID LUBRICANT IF ONE CAN GET IT TO ADHERE IN THIN FILMS, AND CAN CONTROL THE STOICHIOMETRY, OR RATIO OF THE ELEMENTS, DURING GROWTH. BN IS ALSO AN EXTREMELY HARD MATERIAL—NEAR THAT OF DIAMOND, MAKING IT SUITABLE FOR WEAR APPLICATIONS. THIS PROJECT EMPLOYS THE CONCEPT THAT EXCITED STATES, ENERGETIC NEUTRAL PARTICLES, AND IONS IMPROVE THE MOBILITY OF SURFACE ATOMS. THIS IN TURN, IMPROVES THE ORIENTATION AND CRYSTAL SIZE DURING GROWTH, LEADING TO FILMS WITH SUPERIOR PROPERTIES. IN THIS PROJECT, TWO PROPRIETARY TECHNIQUES WILL BE USED TO FABRICATE BN THIN FILMS. THE FIRST TECHNIQUE PRECISELY MEASURES THE RATIO OF EACH ELEMENT IN THE FILM, WHILE IT IS BEING DEPOSITED. THE SECOND TECHNIQUE ADJUSTS FOR CHANGES IN THE NITROGEN CONTENT DURING GROWTH. THE COMBINATION OF THE TWO TECHNIQUES GREATLY INCREASES THE SPEED TO OPTIMIZE PROCESS CONDITIONS. IT'S ESSENTIAL TO PRECISELY CONTROL PROCESS CONDITIONS, BECAUSE CERTAIN PHASES OF BN WILL NOT GROW IF THE STOICHIOMETRY IS INCORRECT. THE TECHNIQUE ALSO USES A BROAD ATOM BEAM SOURCE, WHICH ALLOWS LARGE AREA EPILAYERS TO BE GROWN. THE TECHNIQUE CAN CREATE THIN SEMICONDUCTOR FILMS FOR ELECTRONICS AND WEAR APPLICATIONS. FURTHER, THE PROCESS MAY PERMIT THE SYNTHESIS OF C<sub>3</sub>N<sub>4</sub>, AND ULTRA-HARD MATERIAL, PREDICTED BY THEORY, BUT NOT YET MADE. THE TECHNIQUES CAN ALSO BE USED TO MEASURE THE REACTIVITY OF A FILM TOWARD OTHER SUBSTANCES, SUCH AS WATER OF ATOMIC OXYGEN.

LYNNTECH INC  
RTE 5 - BOX 946A  
COLLEGE STATION, TX 77840  
Program Manager: OLIVER J MURPHY  
Contract #:  
Title: OXIDATION AND WEAR-RESISTANT CARBON-CARBON COMPOSITES  
Topic #: SDIO90-013                      Office:                      ID #: 40800

ADVANCED CARBON/CARBON (ACC) COMPOSITES ARE ONE OF THE FEW MATERIALS THAT ACTUALLY GET STRONGER WHEN HOT, MAKING THEM SUITABLE AS STRUCTURAL COMPONENTS FOR USE AT HIGH TEMPERATURES. HOWEVER, ACC TENDS TO OXIDIZE AT ELEVATED TEMPERATURES WHICH WEAKENS THEM AND LIMITS THEIR USE. THIS PROJECT WILL DEVELOP CERAMIC COATINGS, WHICH IMPROVE ACC'S ABILITY TO RESIST BOTH WEAR AND OXIDATION AT HIGH TEMPERATURES – UP TO 4000 DEGREES F. THE GOAL IS TO DEPOSIT STRONG, DENSE, CRACK-FREE COATINGS AT A HIGH RATE AND AT LOW COST. THE PROCESS CONSISTS OF IMMERSING THE COMPONENT IN A FLUID, THEN APPLYING AN ELECTRIC FIELD, WHICH CAUSES CHARGED PARTICLES TO BE DEPOSITED ON THE SURFACE. THE CHARGED COATING ADHERES STRONGLY TO THE COMPONENT. THE PROJECT WILL IDENTIFY THE OPTIMUM CERAMIC COATING, TAKING INTO ACCOUNT THE COATING'S COMPATIBILITY WITH CARBON, ITS USEFUL TEMPERATURE RANGE, AND ITS ABILITY TO DEAL MICROCRACKS. ACC COMPOSITES CAN SERVE IN HIGH-TEMPERATURE APPLICATIONS, SUCH AS GAS TURBINE ENGINES, ROCKETS, MISSILES, THE NATIONAL

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AEROSPACE PLANE, THE SPACE SHUTTLE, SATELLITES, RAMJETS, SCRAMJETS, AND OTHER HYPERSONIC VEHICLES. ACC CAN ALSO BE MADE INTO NONWETTING CRUCIBLES FOR MOLTEN METALS, AND HIGH-PERFORMANCE DISC BRAKES FOR AIRPLANES AND RACING CARS.

ADVANCED TECHNOLOGY MATERIALS INC  
520-B DANBURY RD  
NEW MILFORD, CT 06776

Program Manager: CHARLES P BEETZ JR

Contract #:

Title: CONTROLLED NUCLEATION AND GROWTH OF SEMICONDUCTING DIAMOND

Topic #: SDIO90-014

Office:

ID #: 40728

DIAMOND HAS A WIDE BANDGAP, ALLOWING A BROAD RANGE OF WAVELENGTHS OF LIGHT FROM UV TO IR TO PASS THROUGH IT WITH LITTLE LOSS OF SPEED. DIAMOND ALSO CONDUCTS HEAT BETTER THAN ANY OTHER MATERIAL - WITH A THERMAL CONDUCTIVITY 50% GREATER THAN COPPER. IN ADDITION, DIAMOND RESISTS THERMAL SHOCK, RADIATION, AND CHEMICAL ATTACK, MAKING DIAMOND THE OPTIMUM MATERIAL FOR HIGH PERFORMANCE SEMICONDUCTOR APPLICATIONS. UNFORTUNATELY, NO ONE HAS YET BEEN ABLE TO REPRODUCIBLY DEPOSIT SEMICONDUCTOR-QUALITY SINGLE-CRYSTAL DIAMOND FILM. THIS PROJECT WILL DEVELOP A PROCESS TO CONSISTENTLY MAKE DIAMOND FILM USING ULTRAHIGH VACUUM CHEMICAL VAPOR DEPOSITION. IT WILL ALSO EMPLOY NOVEL CHEMICALS, SUCH AS SUBSTITUTES FOR METHANE, TO BETTER UNDERSTAND THE MECHANISM OF HOW THE GAS PHASE PRECURSOR INTERACTS WITH THE DIAMOND SUBSTRATE SURFACE. PHASE II WILL FOCUS ON HOW TO INITIATE AND CONTROL THE HIGH PURITY DIAMOND WITH THE GOAL OF PRODUCING P/N JUNCTIONS. DIAMOND SEMICONDUCTORS CAN BE MADE FOR A WIDE RANGE OF APPLICATIONS, INCLUDING HIGH-TEMPERATURE RADIATION HARD SENSORS, HIGH POWER PHOTOCONDUCTIVE SWITCHES, AS WELL AS ACTIVE AND PASSIVE SEMICONDUCTOR DEVICES, SUCH AS SCHOTTKY DIODES AND FIELD EFFECT TRANSISTORS.

ASTRO-POWER INC  
30 LOVETT AVE  
NEWARK, DE 19711

Program Manager: MICHAEL G MAUK

Contract #:

Title: LIQUID PHASE ELECTRO-EPITAXY FOR SILICON AND III-V COMPOUND SEMICONDUCTORS

Topic #: SDIO90-014

Office:

ID #: 40719

LIQUID-PHASE ELECTRO-EPITAXY (LPEE) HAS BEEN DEVELOPED FOR THE PRODUCTION OF NEW COMPOUND SEMICONDUCTOR DEVICE STRUCTURES. LPEE IS THE CURRENT-CONTROLLED CRYSTAL GROWTH OF SEMICONDUCTOR FILMS FROM LIQUID-METAL SOLUTIONS. THIS TECHNIQUE COMBINES THE HIGH MATERIAL QUALITY CHARACTERISTIC OF CONVENTIONAL LIQUID-PHASE EPITAXY WITH THE ADVANTAGES OF OTHER EPITAXY TECHNOLOGIES SUCH AS MOCVD OR MBE (IE. HIGHLY UNIFORM, MIRROR-SMOOTH FILMS OF LARGE AREA AND EXCELLENT LAYER THICKNESS CONTROL). GAAS AND INP FILMS WERE SELECTIVELY GROWN BY ELECTRO-EPITAXY ON PATTERNED, OXIDE-MASKED SUBSTRATES. NOVEL METALLIC SOLVENTS FOR ELECTRO-EPITAXY, SUCH AS BISMUTH, WERE EMPLOYED IN THIS WORK. ELECTRO-EPITAXIAL LATERAL OVERGROWTH OF GAAS OF PATTERNED, OXIDE-MASKED GAAS WAS ALSO DEMONSTRATED. IN ADDITION, LPEE WAS USED IN COMBINATION WITH CHEMICAL VAPOR DEPOSITION FOR THE SELECTIVE GROWTH OF GAAS-ON-SILICON AND INP-ON-SILICON FILMS. LPEE WILL PROVIDE NOVEL DEVICE STRUCTURES FOR LEDS, LASERS, PHOTODETECTORS, SOLAR CELLS, AND MONOLITHICALLY INTEGRATED OPTOELECTRONIC DEVICES WITH SILICON CIRCUITRY.

BREWER SCIENCE INC



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PO BOX GG - 2401 HIGH TECH DR  
ROLLA, MO 65401

Program Manager: DR MARY G MOSS

Contract #:

Title: MINIATURE TEMPERATURE SENSORS

Topic #: SDIO90-014

Office:

ID #: 40731

MANY DEVICES NEED TEMPERATURE SENSORS AS PART OF A CONTROL CIRCUIT, WHICH MEASURES AND COMPENSATES FOR TEMPERATURE CHANGES. THESE APPLICATIONS REQUIRE SMALL, COMPACT SENSORS WITH A LOW THERMAL TIME CONSTANT. A LOW THERMAL TIME CONSTANT MEANS THAT IT TAKES VERY LITTLE TIME FOR HEAT TO TRAVEL FROM ONE SIDE TO THE OTHER SIDE OF THE SENSOR. TO ENSURE GOOD HEAT TRANSFER, THE SENSORS MUST BE IN CLOSE THERMAL CONTACT WITH THE OBJECT. FURTHER, ONE NEEDS TO MINIMIZE RESISTIVE HEATING FROM THE PROCESS OF MEASURING THE TEMPERATURE ITSELF. THIS ADDITIONAL HEAT COULD AFFECT THE SUBSTRATE OR THE SENSOR. THE BEST APPROACH TO MEET THESE GOALS IS TO PRODUCE A THERMALLY SENSITIVE FILM THAT COULD BE DIRECTLY DEPOSITED ONTO A SUBSTRATE. THIS PROJECT WILL EXAMINE THE USE OF POLYACRYLONITRILE (PAN) AS A THERMALLY SENSITIVE THIN FILM. PAN CAN BE SPIN-COATED FROM SOLUTION, AND IONS IMPLANTED INTO ITS SURFACE WILL MAKE IT THERMALLY CONDUCTIVE. MINIATURE PAN TEMPERATURE SENSORS COULD FIND APPLICATIONS IN ELECTRONIC CIRCUITS, INSTRUMENTATION, COMPUTERS, INDUSTRIAL OVENS, CHEMICAL PROCESSING, OPTICS, AND AUTOMOTIVE TEMPERATURE SENSORS. THEY COULD ALSO MONITOR THE TEMPERATURE IN CONTROL ROOMS, ELECTRONIC CLEAN ROOMS, AND OPERATING ROOMS.

DISPLAY-TECH INC  
2200 CENTRAL AVE  
BOULDER, CO 80301

Program Manager: MICHAEL D WAND

Contract #:

Title: TIGHT PITCH FERROELECTRIC LIQUID CRYSTALS FOR ANALOG VOLTAGE- LIMITED ELECTRO-OPTIC MODULATORS

Topic #: SDIO90-014

Office:

ID #: 40729

THIS PROJECT WILL PREPARE FERROELECTRIC LIQUID CRYSTALS (FLCS), PARTICULARLY FOR USE IN LIGHT VALVES. UNLIKE PREVIOUS FLCS, WHICH ARE DIGITAL, DISPLAYTECH WILL CREATE DEFORMED HELIX FLCS (DHFLCS), WHICH ARE ANALOG AND CAN RESPOND TO LOWER VOLTAGES. WHEN AN APPLIED VOLTAGE IS APPLIED TO THE DHFLCS, THE MOLECULES REORIENT THEMSELVES, AND THE LIGHT RESPONDS LINEARLY PROPORTIONAL TO THE VOLTAGE--MAKING THE DEVICE EASIER TO CALIBRATE AND USE IN OPTICAL COMPUTERS. THE DHFLC STRUCTURE IS CHIRAL, I.E. IT CONSISTS OF MIRROR IMAGES THAT CANNOT BE SUPERIMPOSED ONTO ONE ANOTHER--SIMILAR TO YOUR HANDS. THE MOLECULES FORM A HELIX WITH A TIGHT, OR SMALL PITCH, LESS THAN 0.35 MICRONS--1/10 THAT OF PREVIOUS FLCS. PITCH IS THE DISTANCE FROM THE PEAK OF ONE SPIRAL TO THE PEAK OF THE NEXT SPIRAL IN A HELIX. TIGHTER PITCH ALLOWS THE FLC TO RESPOND FASTER FOR THE SAME APPLIED VOLTAGE. DHFLCS CAN ALSO POLARIZE LIGHT, ARE LOW IN VISCOSITY, AND CHEMICALLY STABLE. DHFLCS CAN BE APPLIED IN OPTO-ELECTRONIC COMPUTING, IMAGING SPECTROMETERS, OPTICAL FILTERS AND DISPLAYS. THEY CAN ALSO BE MADE INTO OPTICAL WAVEGUIDES, INTEGRATED CIRCUITS, AND SUPERMARKET SCANNERS WITH NO MOVING PARTS.

ELECTRON TRANSFER TECHNOLOGIES INC  
PO BOX 160  
PRINCETON, NJ 08542

Program Manager: DR WILLIAM M AYERS

Contract #:

Title: POINT OF USE GENERATION OF GASES FOR OPTOELECTRONIC DEVICE FABRICATION

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Topic #: SDIO90-014

Office:

ID #: 40725

OPTOELECTRONIC DEVICES SUCH AS GAASSB REQUIRE SOURCES OF ANTIMONY FOR FABRICATION. THE PUREST GAS SOURCE OF ANTIMONY, STIBINE (SBH<sub>3</sub>), IS NOT AVAILABLE COMMERCIALY. THIS IS BECAUSE THE GAS IS UNSTABLE AT ROOM TEMPERATURE AND CANNOT BE SHIPPED IN COMPRESSED GAS CYLINDERS. A NEW METHOD IS PROPOSED FOR POINT-OF-USE GENERATION OF STIBINE. THIS METHOD WILL PROVIDE GENERATION ON DEMAND FOR DELIVERY DIRECTLY INTO THE FABRICATION REACTOR.

EMCORE CORP  
35 ELIZABETH AVE  
SOMERSET, NJ 08873

Program Manager: DR PETER E NORRIS

Contract #:

Title: ALTERNATIVE ARSENIDE-SOURCES FOR III/V COMPOUND SEMICONDUCTOR DEVICE

Topic #: SDIO90-014

Office:

ID #: 40723

PRESENT METHODS OF MAKING III/V COMPOUND SEMICONDUCTORS, SUCH AS GAAS, ON A PRODUCTION SCALE REQUIRE THE USE OF LARGE QUANTITIES OF ASH<sub>3</sub>. BOTH HYDRIDE AND ORGANOMETALLIC VAPOR PHASE EPITAXY EMPLOY ASH<sub>3</sub> IN CHEMICAL REACTIONS. UNFORTUNATELY, ASH<sub>3</sub> IS EXTREMELY TOXIC, REQUIRING EXPENSIVE MULTIPLE REDUNDANT SAFETY SYSTEMS. THIS PROJECT WILL REPLACE ASH<sub>3</sub> WITH TERTIARYBUTYLARSINE (TBA) TO MAKE III/V COMPOUND SEMICONDUCTORS. TBA IS MUCH SAFER THAN ASH<sub>3</sub>, WHICH IS SO HAZARDOUS THAT IT IS PRECLUDED FROM USE IN SEVERAL LABORATORIES IN HIGHLY POPULATED AREAS. FURTHER, BECAUSE TBA IS LESS TOXIC, IT NEEDS A MUCH SMALLER INVESTMENT IN STORAGE FACILITIES. IN ADDITION TO EPITAXIAL GROWING III/V COMPOUND SEMICONDUCTORS, TBA CAN SERVE IN HIGH-POWER OR LOW-NOISE MICROWAVE DEVICES, AND HIGH-SPEED DIGITAL INTEGRATED CIRCUITS FOR THE MILLIMETER WAVE/MICROWAVE INTEGRATED CIRCUIT (MIMIC) PROGRAM. TBA COULD ALSO ACT AS A CATALYST OR BE SYNTHESIZED INTO NEW COMPOUNDS FOR SEMICONDUCTOR DEVICES.

IBIS TECHNOLOGY CORP  
32A CHERRY HILL DR  
DANVERS, MA 01923

Program Manager: DR MICHAEL GUERRA

Contract #:

Title: SILICON SUBSTRATE GETTERING TO SIMOX FOR REDUCED DEFECT DENSITIES

Topic #: SDIO90-014

Office:

ID #: 40718

SEPARATION BY IMPLANTATION OF OXYGEN, THE SIMOX PROCESS, BOMBARDS A SILICON WAFER WITH OXYGEN IONS. THE SIMOX PROCESS ALLOWS ONE TO PACK THE CIRCUITRY MORE CLOSELY TOGETHER, WHICH IMPROVES PERFORMANCE, RAISES THE OPERATING TEMPERATURE, AND INCREASES THE RESISTANCE TO RADIATION. HOWEVER, THE FULL COMMERCIAL POTENTIAL OF SIMOX CANNOT BE REALIZED UNTIL ONE REDUCES THE NUMBER OF DEFECTS IN SIMOX WAFERS. THIS PROJECT WILL APPLY THE PROCESS KNOWN AS SILICON SUBSTRATE GETTERING TO REDUCE THE DEFECTS AND MINIMIZE THE VARIABILITY FROM WAFER TO WAFER. GETTERING IS THE PROCESS OF ADDING A MATERIAL IN SMALL AMOUNTS TO ABSORB IMPURITIES. GETTERING IMPROVES THE YIELD, REDUCES LEAKAGE CURRENTS, AND ENHANCES RELIABILITY. TO MINIMIZE THE FLAWS, IBIS WILL USE BOTH INTERNAL AND EXTERNAL GETTERING. AFTER OXYGEN IS IMPLANTED, NUCLEATION SITES FORM. INTERNAL GETTERING RAISES THE TEMPERATURE TO DIFFUSE OUT THE OXYGEN, SO THAT OXYGEN PRECIPITATES ONTO THE NUCLEATION SITES, AND DOES NOT FORM IN THE OUTER SILICON REGION WHERE DEVICES WILL LATER BE MADE. THESE FAULT SITES CAN ALSO TRAP HEAVY METAL IMPURITIES. EXTERNAL GETTERING DEPOSITS A THIN, 1 MICRON THICK, LAYER OF POLYSILICON ONTO THE BACKSIDE OF THE WAFER. THE POLYSILICON SINGLE CRYSTAL INTERFACE CREATES A STRAIN LAYER WHERE STACKING FAULTS WILL FORM LOCALLY. SIMOX

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WAFERS CAN BE APPLIED IN ELECTRONIC COMPONENTS, SUCH AS HIGH TEMPERATURE SWITCHES AND ELECTRONIC REPLACEMENTS FOR MECHANICAL ROTORS IN AUTOMOBILES. THEY CAN ALSO BE USED IN AIRCRAFT, ALLOWING THE ELECTRONICS TO BE PLACED CLOSER TO THE ENGINE - THEREBY MINIMIZING WIRING. FURTHER, THEIR RADIATION HARDNESS OPENS UP A WIDE RANGE OF ELECTRONIC APPLICATIONS ON SATELLITES AND SPACECRAFT.

IBIS TECHNOLOGY CORP

32A CHERRY HILL DR

DANVERS, MA 01923

Program Manager: ANDREW B WITTKOWER

Contract #:

Title: NON-DESTRUCTIVE TESTING OF SIMOX STRUCTURES USING SPECTROSCOPIC ELLIPSOMETRY

Topic #: SDIO90-014

Office:

ID #: 40785

IN SEMICONDUCTOR DEVICES, SILICON-ON-INSULATOR (SOI) SUBSTRATES CAN BE FORMED BY SEPARATION BY IMPLANTATION OF OXYGEN: THE SIMOX PROCESS. UNFORTUNATELY, SIMOX MATERIAL CANNOT BE COMMERCIALY PRODUCED WITHOUT CONSISTENT WAFER-TO-WAFER PROPERTIES. HENCE, THIS PROJECT WILL EVALUATE A METHOD, SPECTROSCOPIC ELLIPSOMETRY, FOR ACCURATELY MEASURING THE SURFACE AND SUBLAYER THICKNESS OF SIMOX WAFERS. THE SIMOX PROCESS BOMBARDS A SILICON WAFER WITH OXYGEN IONS, CREATING A THIN LAYER OF SILICON ON TOP. THIS OXYGEN-RICH SUBLAYER ACTS AS A BARRIER, PROTECTING AGAINST HEAT AND RADIATION. UNLIKE OTHER METHODS, SPECTROSCOPIC ELLIPSOMETRY CAN TEST STRUCTURES WITHOUT DAMAGING THE WAFER. IT IS ALSO 10 TIMES FASTER. THE METHOD CONSISTS OF FIRST BATHING THE SUBSTRATE IN POLYCHROMATIC LIGHT, THEN IT MEASURES THE PHASE SHIFTS AND AMPLITUDES OF THE LIGHT REFLECTED OFF THE WAFER. SIMOX WAFERS CAN BE APPLIED IN ELECTRONIC COMPONENTS, SUCH AS HIGH TEMPERATURE SWITCHES, AND ELECTRONIC REPLACEMENTS FOR THE MECHANICAL ROTORS IN AUTOMOBILES. THEY CAN ALSO BE USED IN AIRCRAFT, ALLOWING THE ELECTRONICS TO BE PLACED CLOSER TO THE ENGINE - THEREBY MINIMIZING WIRING. FURTHER, THEIR RADIATION HARDNESS OPENS UP A WIDE RANGE OF ELECTRONIC APPLICATIONS ON SATELLITES AND SPACECRAFT.

J&D SCIENTIFIC INC

1815 W 1ST AVE - STE 102

MESA, AZ 85202

Program Manager: DR LARRY D McCORMICK

Contract #:

Title: DIRECT DEPOSITION OF DIAMOND WITH SCANNING TUNNELING MICROSCOPE

Topic #: SDIO90-014

Office:

ID #: 40726

DIAMOND READILY CONDUCTS HEAT - BETTER THAN ANY OTHER MATERIAL. IT IS TRANSPARENT TO LIGHT, AND CAN WITHSTAND HIGH TEMPERATURE, HARSH CHEMICALS, AND LARGE DOSES OF RADIATION. DIAMOND CAN ALSO BE DOPED TO PRODUCE EITHER SEMICONDUCTING OR CONDUCTING LAYERS. HOWEVER, DIAMOND THIN FILMS ARE DIFFICULT TO GROW IN A CONTROLLED MANNER, AND DIFFICULT TO FABRICATE INTO DEVICES. TO OVERCOME THESE DIFFICULTIES, THIS PROJECT WILL DEVELOP A NEW PROCEDURE TO DEPOSIT DIAMOND-LIKE VAPOR BY SCANNING TUNNELING MICROSCOPY (STM). THE PROCESS USES THE ELECTRIC FIELD UNDER THE STM TIP TO DEPOSIT DIAMOND-LIKE GAS INTO THE FINAL DEVICE CONFIGURATION. STM CAN MOVE MATERIAL ATOM BY ATOM, SO IT GIVES MORE CONTROL. IT CAN LAY DOWN LAYERS ONE ATOM THICK. IT CAN ALSO LAY DOWN ATOMS IN A SPECIFIED PATTERN, ELIMINATING THE NEED FOR ETCHING. THE PROCESS IS SIMPLER THAN OTHER METHODS, RESULTING IN MUCH SMALLER DEVICES WHICH OPERATE MUCH FASTER. THE PROCESS DOES NOT REQUIRE HIGH SUBSTRATE TEMPERATURES, ALLOWING THE USE OF RELATIVELY LOW-TEMPERATURE SUBSTRATES SUCH AS GAAS. DIAMOND THIN FILM CAN BE MADE INTO MANY ELECTRONIC DEVICES, SUCH AS SHOTTKY DIODES, TRANSISTORS, AND MICROWAVE DEVICES. DIAMOND CAN SERVE IN ELECTRONICS REQUIRING HIGH POWER, HIGH FREQUENCY, OR THE EXTREME CONDITIONS IN SPACE.

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KOPIN CORP

695 MYLES STANDISH BLVD

TAUNTON, MA 02780

Program Manager: DR PAUL M AZVRACKY

Contract #:

Title: SILICON-ON-SAPPHIRE REPLACEMENT TECHNOLOGY FOR RADIATION HARDENED CIRCUITS

Topic #: SDIO90-014

Office:

ID #: 40722

SILICON-ON-SAPPHIRE (SOS) TECHNOLOGY PRODUCES CIRCUITS WITH BETTER RADIATION HARDNESS THAN CIRCUITS WITH BULK SILICON SUBSTRATES. HOWEVER, SOS SUFFERS FROM POOR CRYSTAL QUALITY, SMALL WAFER DIAMETERS, AND INCOMPATIBILITY WITH EXISTING SILICON PROCESSING EQUIPMENT. SILICON-ON-INSULATOR (SOI) TECHNOLOGY COULD SOLVE THESE PROBLEMS, AND CAN BE USED WITH SILICON PROCESSING EQUIPMENT, SAVING THE EXPENSE OF INVESTING IN NEW EQUIPMENT. SINCE THE PROCESSED SILICON LAYER IS ISOLATED FROM THE SUBSTRATE BY AN INSULATOR IN SOI, THE EFFECTIVE ELECTRICAL PORTION IS THINNER, SO THERE'S LESS CHANCE THAT INCOMING RADIATION WILL IONIZE THE ACTIVE MATERIAL. HENCE, THE PROBABILITY IS LOWER THAT IONIZED PARTICLES WILL DISRUPT THE NORMAL FUNCTION OF A TRANSISTOR. HOWEVER, IN SOI, THE INSULATOR USED IS SILICON DIOXIDE. RADIATION AT HIGH DOSES CAN IONIZE CHARGES WITHIN THE SILICON DIOXIDE. THE POSITIVE CHARGES GENERATED IN THIS WAY BECOME TRAPPED IN THE SILICON DIOXIDE LAYER AND CAN, AT HIGH ENOUGH DOSES, HAVE A DETRIMENTAL EFFECT ON CIRCUIT PERFORMANCE. IN SOS, THE SILICON LAYER IS SAPPHIRE, WHICH DOES NOT SEEM TO BE EFFECTED BY RADIATION TO THE SAME EXTENT AT SILICON DIOXIDE. THIS PROJECT WILL EMPLOY A PROCESS CALLED ISOLATED SILICON EPITAXY (ISE). ISE WAFERS CAN INCREASE CIRCUIT DENSITY BY 30% AND OPERATE AT UP TO TWICE THE SPEED OF COMPONENTS FABRICATED IN BULK SILICON. SOI ISE WAFERS CAN SERVE IN MEMORY CIRCUITS, HIGH TEMPERATURE ELECTRONICS, AND HIGH VOLTAGE AND RADIATION-HARDENED CIRCUITS, SUCH AS IN MILITARY HARDWARE. THEY CAN ALSO GO INTO HIGH PERFORMANCE ELECTRONIC COMPONENTS FOR INDUSTRIAL EQUIPMENT, COMPUTERS, AUTOMOBILES, AND CONSUMER PRODUCTS. THIS PROJECT PROPOSES A TREATMENT OF THE SILICON/SILICON DIOXIDE INTERFACE WHICH MAY REDUCE THE EFFECT OF RADIATION AND ACHIEVE RADIATION TOTAL DOSE HARDNESS EQUIVALENT TO SOS WHILE PROVIDING ALL THE BENEFITS AND SUPERIOR PERFORMANCE OF SOI.

LINTEL TECHNOLOGY INC

379 ELM DR

ROSLYN, NY 11576

Program Manager: DR CHOU H LI

Contract #:

Title: DIAMOND HEAT SINKS FOR ELECTRONIC CIRCUITS

Topic #: SDIO90-014

Office:

ID #: 40793

DIAMOND CAN SERVE WELL AS A HEAT SINK FOR SEMICONDUCTORS BECAUSE DIAMOND INSULATES AGAINST ELECTRICITY, YET IT READILY CONDUCTS HEAT. TYPE 2A DIAMOND HAS A THERMAL CONDUCTIVITY OF 2000 W/M/K, OR OVER FIVE TIMES THAT OF COPPER. DIAMOND'S COEFFICIENT OF THERMAL EXPANSION (CTE) CLOSELY MATCHES THAT OF SI AND GAAS, WHICH MINIMIZES THERMAL STRESS. DIAMOND IS ALSO RIGID, NON-CONTAMINATING, AND CHEMICALLY STABLE. UNFORTUNATELY, IT'S EXTREMELY DIFFICULT TO BRAZE OR BOND A CERAMIC, SUCH AS A DIAMOND WAFER, TO A METAL SUBSTRATE. TYPICALLY, CERAMIC-METAL JOINTS CANNOT WITHSTAND RAPID THERMAL CYCLING. DIAMOND RESISTS WETTING BY METALS AND MUST FIRST BE SURFACE COATED BEFORE BONDING. PRESENT COATING METHODS ARE COSTLY, COMPLICATED, AND TIME-CONSUMING, AND YET DO NOT PROVIDE HEAT SINKS TO WITHSTAND THE MISMATCH IN CTE BETWEEN METAL AND CERAMIC, LEADING TO EXCESSIVE STRESS BETWEEN THE BONDED COMPONENTS. TO SOLVE THESE PROBLEMS, LINTEL WILL MICROENGINEER THE CRITICAL INTERFACIAL BONDING REGION. THEY WILL APPLY THEIR TUNGSTEN/MOLYBDENUM FUSION-METALLIZING METHOD. THIS METHOD SHOULD PRODUCE DIAMOND HEAT SINKS THAT STRONGLY BOND TO METAL SUBSTRATES. THE BOND SHOULD RESIST BOTH THERMAL

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AND MECHANICAL SHOCK. THE METHOD ALLOWS BONDING AT MASS PRODUCTION RATES, OPENING UP APPLICATIONS FOR DIAMOND HEAT SINKS IN DEFENSE, AUTOMOTIVE, AEROSPACE, AND ELECTRONICS INDUSTRIES. DIAMOND HEAT SINKS CAN SERVE IN LIGHTWEIGHT, RADIATION-HARD, HIGH PERFORMANCE ELECTRONIC CIRCUITS FOR USE IN INTERCEPTORS, SENSORS, AND DATA/SIGNAL PROCESSING DEVICES FOR ANTI-SATELLITE APPLICATIONS. THE HEAT SINKS CAN ALSO FIND USE IN GAAS MICROWAVE POWER DEVICES, LASER DIODES, HEAT-CONDUCTIVE PC BOARDS, AND HIGH-DENSITY IC PACKAGING. THE NEW BONDING METHOD MAY EVEN PERMIT THE FABRICATION OF ACTIVE DIAMOND SEMICONDUCTORS.

MAXDEM INC  
267 S FAIR OAKS AVE  
PASADENA, CA 91105

Program Manager: DR NEIL H HENDRICKS

Contract #:

Title: THERMALLY STABLE LOW DIELECTRIC POLYMERS FOR ADVANCED ELECTRONICS

Topic #: SDIO9C-014

Office:

ID #: 40720

QUINOLINE-BASED POLYMERS CAN BE TAILORED TO OPTIMIZE PROPERTIES SUCH AS SOLUBILITY, DIELECTRIC CONSTANT, THERMAL STABILITY, MOISTURE ABSORPTION, AND ELECTRONIC ABSORPTION. QUINOLINE POLYMERS ABSORB LITTLE MOISTURE. THEIR DIELECTRIC CONSTANT IS LOW: 2.5-2.6, AMONG THE LOWEST OF THE THERMALLY STABLE POLYMERS. FURTHER, THEY DO NOT BEGIN DECOMPOSING BY TGA IN AIR UNTIL 500 DEGREES CELSIUS (932 FAHRENHEIT). PHASE I WILL SYNTHESIZE TWO NEW POLYMERS, WHICH WILL BE BOTH PHYSICALLY AND MECHANICALLY TESTED. THEN, THE SYNTHESIS PROCESS WILL BE FURTHER DEVELOPED TO REDUCE THE COST OF THE POLYMERS. QUINOLINE POLYMERS MAY FIND APPLICATIONS IN REFRACTIVE FILMS, WIRE COATINGS, AND ELECTRO-OPTIC DEVICES. THEY ALSO COULD SERVE IN HIGH DENSITY MICROELECTRONICS PACKAGING AS A DIELECTRIC COATING, BONDING ADHESIVE, OR ENCAPSULATING AGENT.

MERIX CORP  
77 CHARLES ST  
NEEDHAM HEIGHTS, MA 02194

Program Manager: DR THOMAS W MIX

Contract #:

Title: INTEGRATED CIRCUIT SUBSTRATE

Topic #: SDIO90-014

Office:

ID #: 40721

TO DEVELOP FASTER AND MORE POWERFUL CIRCUITS REQUIRES NEW SUBSTRATE MATERIALS. THIS PROJECT WILL DEVELOP A SPECIAL CERAMIC SUBSTRATE MATERIAL WITH A CUSTOM-MADE STRUCTURE. MOST ORDINARY CERAMICS WITH A LOW DIELECTRIC CONSTANT ARE POOR THERMAL CONDUCTORS. HOWEVER, THIS SPECIALLY DESIGNED MATERIAL CAN HAVE AN EXTREMELY LOW DIELECTRIC CONSTANT - LESS THAN 2, COMPARED TO 9.5 FOR THE CURRENTLY USED 96% AL<sub>2</sub>O<sub>3</sub>. YET, THE NEW CERAMIC WILL DISSIPATE HEAT MORE RAPIDLY THAN AL<sub>2</sub>O<sub>3</sub>. A LOW DIELECTRIC CONSTANT MATERIAL ELECTRICALLY INSULATES THE CONDUCTING STRIPLINE, ALLOWING A SIGNAL TO TRAVEL FASTER IN THE STRIPLINE. THE COEFFICIENT OF THERMAL EXPANSION (CTE) OF THE NEW CERAMIC CLOSELY MATCHES THAT OF SILICON, THEREBY AVOIDING EXCESSIVE MECHANICAL STRESS. THE SUBSTRATE CAN ALSO BE METALLIZED. IT HAS A RELATIVELY FLAT, SMOOTH, NONPOROUS SURFACE TO PERMIT THE DEPOSITING OF A FINE PATTERN OF CONDUCTIVE INKS. FURTHER, IT CAN WITHSTAND THE 830 C (1530 F) TEMPERATURES REQUIRED TO FIRE THE CURRENT GENERATION OF INKS. THIS NEW SUBSTRATE WILL LEAD TO FASTER AND HIGHER-POWER IC CHIPS.

SCHMIDT INSTRUMENTS INC  
2476 BOLSOVER - #234

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HOUSTON, TX 77005

Program Manager: DR HOWARD SCHMIDT

Contract #:

Title: N-TYPE SEMICONDUCTING DIAMOND FOR DEVICE APPLICATIONS

Topic #: SDIO90-014

Office:

ID #: 40730

AT PRESENT, NO ACCEPTABLE METHOD EXISTS FOR PRODUCING N-TYPE SEMICONDUCTING DIAMOND AT LOW PRESSURE. IN THIS PROJECT, HOWEVER, PHASE I WILL ATTEMPT A NOVEL METHOD OF PRODUCING N-TYPE SEMICONDUCTING DIAMOND BY INCORPORATING DESIRED ELEMENTS INTO DIAMOND, DURING GROWTH UNDER LOW PRESSURE CHEMICAL VAPOR DEPOSITION. TO DEMONSTRATE THE METHOD, ALKALI DOPED SINGLE CRYSTAL DIAMOND WILL BE PRODUCED AND CHARACTERIZED. AFTER ESTABLISHING A RELIABLE PROCESS IN PHASE I, SCHMIDT INSTRUMENTS WILL FABRICATE COMPLEMENTARY FIELD EFFECT TRANSISTOR AND BIPOLAR DEVICES, AS WELL AS CIRCUITS IN DIAMOND. RELIABLE PRODUCTION OF N-TYPE AND P-TYPE SEMICONDUCTING DIAMOND WILL PERMIT FABRICATION OF MANY NEW DIAMOND ELECTRONIC COMPONENTS, WITH APPLICATIONS AT HIGH TEMPERATURES AND RADIATION, AS WELL AS IN VERY HIGH FREQUENCY/HIGH POWER RADAR AND COMMUNICATION SYSTEMS.

SPIRE CORP

PATRIOTS PK

BEDFORD, MA 01730

Program Manager: STANLEY M VERNON

Contract #:

Title: ATOMIC-SCALE CONTROL OF DOPANT PLACEMENT FOR ADVANCED QUANTUM ELECTRONICS

Topic #: SDIO90-014

Office:

ID #: 40717

SPIRE CORPORATION IS DEVELOPING ATOMIC-SCALE LOCALIZATION OF DOPANT ATOMS WITHIN III-V MATERIALS GROWN IN A PRODUCTION-SIZED METALORGANIC CHEMICAL VAPOR DEPOSITION SYSTEM. EPITAXIAL STRUCTURES HAVING DOPANTS LOCALIZED TO FORM LOW-DIMENSIONAL CONDUCTORS (QUANTUM BOXES, WIRES, WELLS, AND DOPING SUPERLATTICES) CAN LEAD TO NOVEL DEVICES BASED ON VARIOUS QUANTUM EFFECTS, TO MUCH SMALLER DEVICES (WITH NANOMETER SCALE DIMENSIONS), AND TO IMPROVE RADIATION HARDNESS. THE BASIC APPROACH IS TO USE THE NUCLEATION SITES FORMED BY THE ATOMIC-SCALE STEP EDGES AND CORNERS WHICH EXIST ON A III-V SUBSTRATE ORIENTED A FEW DEGREES OFF THE (100) AXIS. THESE SITES WILL FACILITATE THE CONFINEMENT OF MOBILE DOPANT ARRIVING ON THE SURFACE DURING THE GROWTH PAUSE. SUBSEQUENT BURYING OF THESE REGIONS BY NORMAL LAYER GROWTH ACCOMPLISHES THE GOAL OF CONTROLLING THE ELECTRONIC ENERGY BANDS ON A NANOMETER SCALE IN ONE, TWO, OR THREE DIMENSIONS. THE PHASE I EFFORT ESTABLISHED THE MOCVD TECHNIQUE NEEDED TO CONFINE SI DOPANT PLACEMENT IN ONE DIMENSION ("DELTA DOPING") AND WILL DEMONSTRATE THE EFFECTIVENESS OF THIS METHOD BY USING IT IN THE GROWTH OF A HIGH-ELECTRON-MOBILITY TRANSISTOR (HEMT) STRUCTURE. THE PHASE II PROGRAM WILL SEEK TO EXTEND THESE CONCEPTS TO HIGHER DIMENSIONS, OTHER DOPANT SPECIES, AND OTHER ADVANCED DEVICE STRUCTURES.

APA OPTICS INC

2950 NE 84TH LN

BLAINE, MN 55434

Program Manager: DR M ASIF KHAN

Contract #:

Title: ATOMIC LAYER CHEMICAL VAPOR DEPOSITION OF BISMUTH-CALCIUM-STRONTIUM COPPER-OXYGEN OVER A LOW DIELECTRIC SUBSTRATE

Topic #: SDIO90-015

Office:

ID #: 40787

APA OPTICS WILL DEPOSIT LAYERS OF HIGH CRITICAL TEMPERATURE (TC) BICASRCUO OVER A COMPOSITE

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AL(X)GA(1-X)N/SAPPHIRE SUBSTRATE, BY AN ATOMIC LAYER CHEMICAL LAYER DEPOSITION (CVD) PROCESS. THIS ATOMIC LAYER PROCESS SHOULD REDUCE THE EPITAXY TEMPERATURE WELL BELOW THAT REQUIRED FOR METAL-ORGANIC CVD, THEREBY ELIMINATING THE NEED FOR ANNEALING. (EPITAXY IS THE GROWTH OF ONE SINGLE CRYSTAL MATERIAL ON TOP OF ANOTHER SIMILAR MATERIAL). THE PROJECT WILL ALSO EMPLOY A SPECIAL SUBSTRATE STACK, WHICH HAS A LOWER DIELECTRIC CONSTANT, HIGHER THERMAL CONDUCTIVITY, AND STRONGER MECHANICAL STRENGTH THAN GAAS. THESE PROPERTIES MAKE THE MULTILAYER STACK SUITABLE FOR FABRICATING HIGH FREQUENCY, LOW LOSS MONOLITHIC MICROWAVE INTEGRATED CIRCUITS (MMICS) WITH SUPERCONDUCTOR ELECTRODES. IN ADDITION TO MMICS, THE PROJECT CAN YIELD HIGH PERFORMANCE SENSORS AND LOW RESISTIVE LOSS INTERCONNECTS FOR USE IN COMMERCIAL COMMUNICATION SYSTEMS. FURTHER, THE PROJECT WILL PRODUCE HIGH TEMPERATURE SUPERCONDUCTING FILMS. HENCE, THE RESULTING SENSORS AND MMICS DON'T NEED TO BE COOLED TO AS LOW TEMPERATURES AS OTHER SUPERCONDUCTORS.

CONDUCTUS INC  
969 W MAUDE AVE  
SUNNYVALE, CA 94086  
Program Manager: JOHN M POWELL  
Contract #:

Title: MULTI-GHZ SHIFT REGISTERS IN NIOBIUM NITRIDE AND YTTRIUM BARIUM COPPER OXIDE  
Topic #: SDIO90-015                      Office:                      ID #: 40806

A SHIFT REGISTER IS A VERSATILE COMPUTER COMPONENT THAT MANIPULATES BITS. PRESENT SHIFT REGISTERS AND OTHER COMPUTER COMPONENTS FUNCTION AT 33 MHZ, WHILE SUPERCONDUCTING SHIFT REGISTERS WORK AT SPEEDS OF TENS OF GHZ - 300 TO 1000 TIMES FASTER. HOWEVER, PREVIOUS SUPERCONDUCTING SHIFT REGISTER CIRCUITS WERE BUILT USING LOW-TEMPERATURE SUPERCONDUCTORS, OPERATING AT 4.2 K. THIS STUDY WILL ADAPT ONE OR MORE LOW-TEMPERATURE SUPERCONDUCTOR CIRCUITS FOR USE AT HIGHER TEMPERATURES, 8K OR IN THE 50-70 K RANGE. AT HIGHER TEMPERATURES, ONE NEEDS LESS REFRIGERATION, WHICH MEANS LESS POWER. FURTHER, THE REFRIGERATOR SYSTEM CAN BE MADE SMALLER. THE PROJECT WILL ALSO MAKE COMPONENTS, SUCH AS SQUIDS, WITH HIGH TEMPERATURE SUPERCONDUCTORS (HTS). HTS SHIFT REGISTERS COULD BE USED IN A VARIETY OF OPERATIONS, INCLUDING FAST-IN, SLOW-OUT STORAGE FOR SHORT PULSES, SERIAL MEMORY, MULTIPLEXING, DEMULTIPLEXING (SEPARATING MULTIPLE SIGNALS), CORRELATING, CONVOLUTING, AND BINARY COUNTING. THEY COULD ALSO WORK IN INFRARED DETECTORS, WHICH NATURALLY PROVIDE THE 8-10 K SURROUNDINGS. THIS TECHNOLOGY COULD IMPROVE WIDEBAND COMMUNICATIONS, RADAR, AND FIBER-OPTIC COMMUNICATION SYSTEMS.

CREARE INC  
PO BOX 71  
HANOVER, NH 03755  
Program Manager: KENT GOEKING  
Contract #:

Title: THIN FILM GROWTH OF BI-CA-SR-CU-OXIDE SUPERCONDUCTORS ON LAGAO3 SUBSTRATES  
Topic #: SDIO90-015                      Office:                      ID #: 40788

HIGH-FREQUENCY AND LOW-NOISE DEVICES REQUIRES HIGH TEMPERATURE SUPERCONDUCTING (HTS) THIN FILMS ON LOW-LOSS SUBSTRATES. THIS PROJECT WILL GROW SINGLE CRYSTAL THIN FILMS OF HTS  $\text{Bi}_2\text{CaSr}_2\text{Cu}_2\text{O}_x$  DIRECTLY ONTO LOW DIELECTRIC CONSTANT LAGAO3 SUBSTRATES BY LIQUID PHASE EPITAXY. THESE FILMS CAN CARRY HIGHER CURRENTS, HAVE GREATER STABILITY, LOWER LOSSES, AND FEWER DEFECTS THAN CONVENTIONAL FILMS. THE PROCESS CONSISTS OF A SMALL CRUCIBLE THAT CONTAINS A SATURATED MOLTEN LIQUID OF THE SUPERCONDUCTING COMPOUND DISSOLVED IN AN ALKALI CHLORIDE SALT, SUCH AS KCL. UNDISSOLVED SUPERCONDUCTING MATERIAL RESTS AT THE BOTTOM OF THE CRUCIBLE - TO REPLENISH THE SOLUTION AS THE CRYSTAL GROWS. THE FURNACE HEATS THE BOTTOM OF THE CRUCIBLE TO A SLIGHTLY HIGHER TEMPERATURE THAN THE SURFACE,

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CAUSING HEAT TO FLOW BY CONVECTION FROM THE BOTTOM TO THE TOP. WHEN A SUBSTRATE IS INTRODUCED AT THE TOP SURFACE, IT BEGINS TO NUCLEATE, AND A THIN FILM FORMS. THE TECHNIQUE ACCURATELY CONTROLS THE PHASE UNIFORMITY AND GROWTH RATE. THE METHOD CAN PRODUCE COMMERCIAL SCALE SINGLE CRYSTAL SUPERCONDUCTING FILMS FOR APPLICATIONS IN MICROELECTRONICS. IT CAN MAKE LARGE DIAMETER FILMS AT LOW COST FOR APPLICATIONS, SUCH AS COMPUTERS, ELECTROMAGNETIC RADIATION SENSORS, AND HIGH-FREQUENCY COMMUNICATION EQUIPMENT.

EMCORE CORP  
35 ELIZABETH AVE  
SOMERSET, NJ 08873

Program Manager: DR PETER E NORRIS

Contract #:

Title: METAL ORGANIC CHEMICAL VAPOR DEPOSITION GROWTH OF YTTRIUM BARIUM CARBON OXIDE ON LARGE AREA SUBSTRATES

Topic #: SDIO90-015

Office:

ID #: 40734

PLASMA-ASSISTED (PA) METAL ORGANIC CHEMICAL VAPOR DEPOSITION (MOCVD) MAY BE A BETTER PROCESS FOR MAKING HIGH-TEMPERATURE SUPERCONDUCTING THIN FILMS (HTSC), SUCH AS YBCO. PA MOCVD USES ELECTRON KINETIC ENERGY INSTEAD OF CONVENTIONAL THERMAL ENERGY, ALLOWING THE FILM TO BE DEPOSITED AT A LOWER TEMPERATURE. PA MOCVD ALSO ENHANCES GROWTH OF HTSC FILMS WITH THE PRESENCE OF KEY ATOMIC AND IONIC SPECIES. THIS PERMITS THE FILM TO BE GROWN ON A WIDER VARIETY OF SUBSTRATES, AND ON LARGE-SCALE SUBSTRATES—UP TO 150MM IN DIAMETER. LA- AND GAALO<sub>3</sub> SHOW A CLOSE LATTICE MATCH TO YBCO, OFFER IMPROVED MICROWAVE PROPERTIES, AND ARE COMMONLY USED SUBSTRATES. HOWEVER, THEY ARE EXPENSIVE, THEIR QUALITY IS POOR, AND THE MAXIMUM AREA AVAILABLE IS ONLY 50MM IN DIAMETER. SAPPHIRE COSTS MUCH LESS, AND LARGE AREA SAPPHIRES ARE READILY AVAILABLE. THUS, THIS PROJECT WILL USE A SAPPHIRE SUBSTRATE, THEN DEPOSIT AN ALUMINATE BUFFER LAYER BY MOCVD PRIOR TO THE GROWTH OF YBCO. THE PROCESS CAN FORM HIGHLY ORIENTED, HIGH DENSITY, MIRROR-SMOOTH SURFACE, AND LOW-CARBON YBCO FILMS. AN IMMEDIATE APPLICATION FOR THIS PROCESS IS TO MAKE HIGH QUALITY, LIQUID-NITROGEN-TEMPERATURE (77K OR ABOVE) SUPERCONDUCTING QUANTUM INTERFERENCE DEVICES (SQUIDS), WHICH SERVE TO DETECT CHANGES IN MAGNETIC FLUX. THE PROCESS COULD ALSO LEAD TO ADVANCES IN FABRICATING DEVICES SUCH AS LONG-WAVELENGTH INFRARED DETECTORS, INTEGRATED CIRCUIT INTERCONNECTS, SHIFT REGISTERS, VORTEX MEMORY CELLS, AND JOSEPHSON JUNCTIONS.

EXCEL SUPERCONDUCTOR INC  
140-20 KEYLAND CT  
BOHEMIA, NY 11716

Program Manager: DR RAMA RAO

Contract #:

Title: SENSITIVE BOLOMETER FABRICATED WITH HIGH TC TBACACUO SUPERCONDUCTOR

Topic #: SDIO90-015

Office:

ID #: 40736

THIS PROJECT WILL DEVELOP A HIGHLY SENSITIVE BOLOMETER IN THE 10-100 MICRON REGION (FAR INFRARED AND SUB-MM) FABRICATED WITH THIN FILMS OF HIGH TC SUPERCONDUCTOR TL-BA-CA-CU-O. A BOLOMETER IS A DEVICE THAT SENSES AND MEASURES THERMAL OR HEAT RADIATION. UNLIKE OTHER HIGH TC SUPERCONDUCTORS, TL-BA-CA-CU-O DOES NOT NEED RARE EARTH ELEMENTS. TL-BA-CA-CU-O'S HIGH TC OF 125 K ALLOWS IT TO OPERATE EFFICIENTLY AT LIQUID NITROGEN TEMPERATURE (LNT), I.E. 77 K. TL-BA-CA-CU-O CAN BETTER RESIST MOISTURE AND CARBON-DIOXIDE. THE BOLOMETER USES EXTREMELY SMOOTH AND SEMI-TRANSPARENT TL-BA-CA-CU-O FILMS AS THIN AS 80 NM. THESE THIN FILMS ARE PATTERNED IN A MEANDERING SHAPE TO LENGTHEN THE ELECTRICAL PATH, WHICH IMPROVES THE RESPONSIVITY OF THE DETECTOR. THE RESPONSIVITY IS 10E4 VOLTS/WATT, SEVERAL ORDERS OF



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MAGNITUDE HIGHER THAN PRESENT SUB-MM DETECTORS OPERATING AT LNT. THE FREQUENCY RESPONSE IS LESS 10 PSEC (10E-12), FASTER THAN THE HIGHEST SPEED SEMICONDUCTOR DEVICES. THE BOLOMETER CAN ALSO DETECT VERY SHORT PULSES, HIGH FREQUENCY OPTICAL SIGNALS, AND IN THE FAR INFRARED REGION - BELOW 20 MICRONS, WHERE PRESENT EFFICIENT DETECTORS OPERATING AT LNT CANNOT. THE DEVICE COULD BE APPLIED IN SUB-MM SPECTROMETERS, RADIOMETERS, NIGHT VISION, AND OPTICAL COMMUNICATIONS.

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Program Manager: ROBERT SINCLAIR  
Contract #:  
Title: NIOBIUM NITROGEN JOSEPHSON JUNCTION STUDIES & DEVICES  
Topic #: SDIO90-015                      Office:                      ID #: 40733

PRESENTLY, NIOBIUM NITROGEN (NBN)-BASED JOSEPHSON JUNCTIONS ARE PROBABLY THE BEST CANDIDATES FOR SUPERCONDUCTING LOGIC CIRCUITY. UNFORTUNATELY, CURRENT TECHNOLOGY CANNOT PRODUCE BARRIER FILMS OF UNIFORM THICKNESS, CONSISTENT FROM BATCH TO BATCH. UNIFORM MGO BARRIER LAYERS ARE NEEDED TO PREVENT OXIDES FROM FORMING, WHICH REACT WITH NBN COUNTERELECTRODES-CAUSING A SHORT CIRCUIT. THIS PROJECT WILL MAKE NBN INSULATORS AND JOSEPHSON JUNCTIONS WITH VERY HIGH YIELDS. THE PROJECT WILL PREPARE BARRIER LAYERS ON SUPERCONDUCTING NBN FILMS, WHICH ALLOWS NBN COUNTERELECTRODES TO BE DEPOSITED WITHOUT DAMAGING THE BARRIER LAYER. THIS THIN-FILM FABRICATION METHOD ALSO IMPROVES REPRODUCIBILITY. IN ADDITION, THE METHOD INCREASES CONTROL OF THE CRITICAL CURRENT. THE METHOD PRODUCES CIRCUITS THAT ARE RUGGED, I.E. THEY CAN BE THERMALLY CYCLED. FURTHER, THE CIRCUITS CAN BE USED WITH MECHANICAL CLOSED-CYCLE REFRIGERATORS, AND DO NOT REQUIRE COOLING BY LIQUID HELIUM. APPLICATIONS FOR THE CIRCUITS INCLUDE REFLECTOMETERS, WAVE MIXERS, AND DIGITAL LOGIC GATES. NBN LOGIC CIRCUITS OF 10 (5TH POWER) JUNCTIONS OR HIGHER COULD BE BUILT, WHICH WOULD MAKE POSSIBLE FASTER MICROPROCESSORS.

HYPRES INC  
500 EXECUTIVE BLVD  
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Program Manager: DR GERT HOHENWARTER  
Contract #:  
Title: SUPERCONDUCTING HIGH TEMPERATURE THIN-FILM VORTEX-FLOW TRANSISTOR  
Topic #: SDIO90-015                      Office:                      ID #: 40808

IN THIS PROJECT, HYPRES, INC. WILL FABRICATE THIN-FILM TRANSISTORS OUT OF HIGH TEMPERATURE SUPERCONDUCTORS. IN THIS TRANSISTOR-LIKE DEVICE, ONE INPUTS A CURRENT, WHICH CONTROLS A MAGNETIC FIELD. WHEN THE INITIAL CURRENT CROSSES MAGNETIC LINES OF FLUX, THIS CREATES INDIVIDUAL CIRCULATING CURRENTS. SEVERAL OF THESE CURRENTS CAN MOVE THROUGH WEAK SUPERCONDUCTORS, ALTERING THE RATE OF NUCLEATION OF VORTICES. THIS IN TURN CONTROLS THE DEVICE'S RESISTANCE, THEREBY CONTROLLING THE OUTPUT. VORTEX-FLOW TRANSISTORS OFFER LOW INPUT IMPEDANCE-MUCH LOWER THAN SEMICONDUCTORS. AND THEY REQUIRE LESS POWER. FURTHER, THEY PRODUCE A LARGE VOLTAGE OUTPUT SWING: FROM 0 TO 50 MILLIVOLTS, COMPARED TO ONLY 0 TO 3 MILLIVOLTS FOR A TYPICAL JOSEPHSON JUNCTION. THIS LARGE VOLTAGE OUTPUT SWING MAKES IT EASIER TO DRIVE A SEMICONDUCTOR. VORTEX-FLOW TRANSISTORS CAN CONNECT LOW TEMPERATURE (LT) SUPERCONDUCTING DEVICES, SUCH AS JOSEPHSON JUNCTIONS, TO ROOM TEMPERATURE (RT) SEMI-CONDUCTORS. VORTEX-FLOW TRANSISTORS CAN OPERATE AT OR ABOVE 77 K, ALLOWING THE USE OF LIQUID NITROGEN COOLING, WHICH IS FAR LESS COSTLY THAN COOLANTS FOR LT SUPERCONDUCTORS. THIS DEVICE PERMITS THE DEVELOPMENT OF HYBRID DIGITAL ELECTRONICS, WHICH INCORPORATES BOTH LT SUPERCONDUCTORS AND DIGITAL ELECTRONICS IN ONE DEVICE, MAKING POSSIBLE FASTER READOUTS,

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SUCH AS IN A/D CONVERTERS. THE NEW TRANSISTORS CAN ALSO SERVE IN PHASE SHIFTERS, OSCILLATORS, AMPLIFIERS, AND EVEN DIGITAL LOGIC CIRCUITS.

HYPRES, INC.  
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Program Manager: DR. OSTERMAN  
Contract #:  
Title: THIN FILM SUPERCONDUCTING QUANTUM INTERFERENCE DEVICE AMPLIFIERS  
Topic #: SDIO90-015 Office: ID #: 70000

A TECHNIQUE USING OFF-THE-SHELF CARBON FOAM IS BEING DEVELOPED TO CREATE CARBON COMPOSITE 3-D PREFORMS. THE TECHNIQUE IS LESS COMPLEX AND MAY RESULT IN SIGNIFICANTLY LOWER COSTS AND BETTER PROPERTIES THAN CONVENTIONAL MULTIDIRECTIONAL WEAVING, SPINNING, OR KNITTING. STARTING WITH THE CARBON FOAM SUBSTRATE, A LAYER OF HIGHLY GRAPHITIZABLE CARBON WILL BE VAPOR-DEPOSITED, CREATING AN ISOTROPIC THREE-DIMENSIONAL GRAPHITE HONEYCOMB STRUCTURE. THIS GRAPHITIC FOAM CAN THEN BE REINFORCED BY GROWING CATALYTIC CARBON VAPOR-DEPOSITED (CCVD) FIBERS WITHIN THE PREFORM. RESULTING PREFORMS WILL BE SUBSEQUENTLY DENSIFIED USING CONVENTIONAL MATRIX MATERIALS, INCLUDING EPOXY AND PITCH. EXPECTED COMPOSITE PROPERTIES INCLUDE EXCELLENT STIFFNESS-TO-WEIGHT, GOOD STRENGTH-TO-WEIGHT, AND EXCELLENT THERMAL AND ELECTRICAL CONDUCTIVITY. AEROSPACE APPLICATIONS INCLUDE STRUCTURAL COMPONENTS, BRAKES, CENTRIFUGE ROTORS, FLYWHEELS, HELICOPTER BLADES, AND NOSE CONES.

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MESA, AZ 85202  
Program Manager: DR LARRY D McCORMICK  
Contract #:  
Title: FABRICATION OF HIGH TEMPERATURE SUPERCONDUCTING JUNCTIONS WITH THE SCANNING TUNNELING MICROSCOPE  
Topic #: SDIO90-015 Office: ID #: 40735

THIS PROJECT USES SCANNING TUNNELING MICROSCOPY (STM) TO ETCH, A SUITABLE SUBSTRATE, THEN DEPOSITS A HIGH TEMPERATURE SUPERCONDUCTING (HTSC) MATERIAL. THE RESULTING COMPONENT MAY BECOME PART OF A HTSC DEVICE. THIS PROJECT WILL CREATE A HTSC MATERIAL, SUCH AS YBA<sub>2</sub>CU<sub>3</sub>O<sub>7-X</sub>, IN CLOSELY SPACED LINES—ONE NANOMETER APART. THESE LINES ARE PRECURSORS TO PRACTICAL ELECTRONIC DEVICES, SUCH AS JOSEPHSON JUNCTIONS. THE PROJECT WILL MONITOR STM VARIABLES, INCLUDING APPLIED TIP VOLTAGE, OHMIC POTENTIAL DROP ACROSS THE IONIZED GASES, PROXIMITY TO THE TIP OF THE MATERIAL, AND TIP SCAN RATE. BY CONTROLLING THE MOTION OF THE STMS TIP, AND SINCE THE TIP CAN BE RAPIDLY MOVED IN STEPS AND IN VERY SMALL INCREMENTS OF LESS THAN AN ANGSTROM, THIS ALLOWS THE SUBSTRATE TO BE ETCHED ALMOST CONTINUOUSLY. FURTHER, IT ALLOWS THE HTSC MATERIAL TO BE CONTINUOUSLY DEPOSITED IN THE DESIRED PATTERN. THIS RAPID, PRECISE TECHNIQUE CAN EFFICIENTLY PRODUCE SUPERCONDUCTING ELECTRONIC DEVICES, WHICH ARE FASTER THAN CURRENT DEVICES. THE DEVICE CAN BE APPLIED IN SENSORS, AS WELL AS MEASURING CRYOGENIC TEMPERATURES, CURRENTS, AND MAGNETIC FIELDS. IT CAN ALSO SERVE IN ELECTRONIC SWITCHES, ANALOG TO DIGITAL CONVERTERS, AND COMPUTER MEMORY.

SUPERCONDUCTOR TECHNOLOGIES INC  
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SANTA BARBARA, CA 93111  
Program Manager: MICHAEL J MOSKOWITZ  
Contract #:

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Title: SUBSTRATES FOR SUPERCONDUCTING ELECTRONIC COMPONENTS

Topic #: SDIO90-015

Office:

ID #: 40792

HIGH TEMPERATURE SUPERCONDUCTORS (HTSCS) CAN GREATLY REDUCE CIRCUIT LOSSES. HOWEVER, EFFECTIVE SUPERCONDUCTORS REQUIRE COMPATIBLE LOW-LOSS SUBSTRATE MATERIALS, WHICH CAN NOT YET BE MADE AND RELIABLY REPRODUCED. TO DEVELOP AND CONTROL THESE SUBSTRATES, A VIABLE TECHNIQUE FOR MEASURING THE LOSS TANGENT IS ESSENTIAL. TODAY, THERE ARE NO PRACTICAL TECHNIQUES FOR MEASURING THE LOSS TANGENT OF EXTREMELY LOW LOSS MATERIALS DURING PROCESSING. THIS PROJECT PROPOSES A TECHNIQUE THAT USES A HIGH Q MICROSTRIP MICROWAVE RESONATOR WITH INTERCHANGEABLE SUBSTRATES. IT COMPARES THE SUBSTRATE UNDER TESTING TO A KNOWN, LOW-LOSS SAPPHIRE SUBSTRATE. IT WORKS OVER A WIDE RANGE OF FREQUENCIES AND CAN ENDURE CRYOGENIC TEMPERATURES. THE TECHNIQUE IS FAST, SENSITIVE, AND NON-DESTRUCTIVE. IT CAN HELP DETERMINE THE PROPERTIES OF LAALO<sub>3</sub>, AS WELL AS FUTURE SUBSTRATE MATERIALS. THE INFORMATION OBTAINED FROM LAALO<sub>3</sub> (OR OTHER DIELECTRIC MATERIALS) WILL ENABLE MICROWAVE CIRCUIT ENGINEERS TO DESIGN MICROSTRIP DEVICES WITH THIN FILM SUPERCONDUCTORS, AND HELP MATERIAL SCIENTISTS TO IMPROVE SUBSTRATES FOR HTSCS IN MICROWAVE APPLICATIONS. ALSO, THE SYSTEM COULD BE DEVELOPED INTO A TEST TO QUALIFY MATERIALS DURING PRODUCTION.